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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 1

North Carolina State Library
Raleigh

THE POSSIBILITIES OF A MAPLE SUGAR INDUSTRY IN WESTERN NORTH CAROLINA

BY

WILLIAM WILLARD ASHE

ASSISTANT IN FORESTRY

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LETTER OF TRANSMITTAL.

Raleigh, N. C., June 1st, 1897.

To his Excellency, Hon. D. L. Russell,
Governor of North Carolina.

Sir :—I have the honor to submit for publication, as the first of a series of economic papers, a special report on the possibilities of a maple sugar industry in the mountain counties of western North Carolina. In connection with the development of our forest resources, there are a number of lesser industries—the subject of this paper being one of them—the development of which is certain to add materially to the prosperity of our people.

The *Bulletins* now being published by the survey are intended mainly for distribution outside of the state, with a view to attracting capital. The *economic papers*, of which this is the first to be issued, are intended primarily for distribution in North Carolina, with a view to encouraging our own people to protect and develop certain latent resources on their own farms.

Yours obediently,
J. A. Holmes,
State Geologist.

PREFACE.

There is now made annually in the mountain counties of western North Carolina—especially in Alleghany, Ashe, Watauga and Mitchell—a limited quantity of both syrup and sugar from the sap of the sugar maple or sugartree. Owing to the lack of proper appliances and skill in the making of these materials, both the syrup and sugar are often of inferior quality and sell at low prices ; but there is no reason why this should continue to be the case. With the use of proper care and appliances the maple sugar and syrup manufactured from these trees in western North Carolina should be as good as similar products made in New England, and the maple trees in portions of our mountain region are sufficiently numerous to admit of the large expansion of the industry.

Along the slopes of the mountains where the land surfaces are too rugged or steep to permit of the satisfactory cultivation of ordinary crops, less valuable trees might be gradually removed and replaced by maples, which may either be transplanted to such places while small trees, or grown from seed planted for this purpose. In this way a large number of maple trees can in a few years be brought together so as to constitute a " sugar bush " or sugar orchard ; and these rugged, southerly mountain slopes, which are now unproductive, can be made to yield an annual income to their owners. Many New England farmers regard the maple sugar grove as the best paying part of their farms.

The aim of this report is two-fold : (1) to give such information concerning the appliances used and methods followed in the manufacture of maple sugar and syrup as will enable persons who desire to make these products in western North Carolina, to do so in the most satisfactory manner ; and (2) to show those interested in this subject how they may protect and enlarge the industry by taking better care of the maple trees and increasing the number of these trees either by planting the seed or transplanting young trees, or both. Its object, therefore, is not so much to describe an existing industry as it is to point out how an industry may be developed in our mountain counties; and I trust it may prove of service in that direction.

At the end of the report, which is largely a compilation, will be found a list of the papers consulted and made use of in its preparation, and a list of the dealers in evaporators and other articles used in the manufacture of maple syrup and sugar.

I am indebted to Mr. T. B. Barney, of Underhill, Vt., one of the largest and most successful makers of maple syrup and sugar in this country, for his kindness in reading and revising this paper. He writes me that the greatest essentials to success in this industry are the highest degree of *neatness* and *dispatch* in every part of the process.

J. A. Holmes.

THE POSSIBILITIES OF A
MAPLE SUGAR INDUSTRY
IN WESTERN NORTH CAROLINA.

BY W. W. ASHE.

SUGAR YIELDING TREES.

The tree, the sap of which is most extensively used for procuring sugar, is usually known as the *sugar maple*, but in the northern states *rock maple* is a common field designation, while in the mountains of North Carolina it is ordinarily called *sugartree*. The sap of other closely related trees is sometimes used along with that of the sugar maple, the trees being tapped in the same way and the sap mixed, without distinction, with that of the sugar maple. The red maple, striped maple (moosewood or swamp dogwood of the higher mountains), ash-leaf maple (box elder), and, particularly, the white maple yield sweet sap; but there is not so large a proportion of sugar in their sap as in that from the sugar maple, and the running season is shorter, so that fewer runnings can be made before the sap becomes strongly flavored and "buddy" with the early opening of the buds. Although there is no authentic record of the red maple, the most common maple throughout our mountain counties, being tapped for sap in North Carolina, yet it is very largely tapped in Vermont, which is the largest maple sugar producing state; and the sugar made from it cannot be distinguished from that made from the sugar maple.

Dr. Hyram Cutting estimated that nearly one-half of the trees tapped in Vermont are not sugar maples, but are some other species of maples; and in some groves one-half of the trees tapped are red maples. It is probable that red maples will yield sap in the mountainous parts of North Carolina as abundantly as the sugar maples; and where found in groves with sugar maples which are tapped, they should be tapped in the same manner as the sugar maple, and should receive the same care and protection.

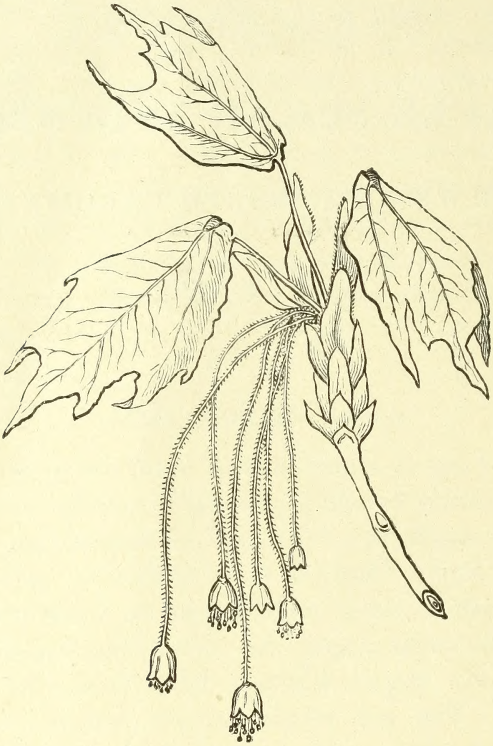

Fig. 1. FLOWERS OF THE SUGAR MAPLE.

HOW TO DISTINGUISH THE MAPLES.

The three maples occurring most abundantly in the mountain counties are to be distinguished from all other trees by having three or five-lobed leaves placed opposite on the twigs, and borne on rather long leafstems, and fruit, hanging in clusters at or near the end of the twigs, consisting of two light, winged seed joined at their base to a common stalk. (See Fig. 2 on next page.)

The sugar maple and the red maple are large trees with furrowed gray bark.

The *sugar maple* has the bark broken into rather large plates, which often hang loosely to the tree. The leaves, as shown in Figure 2, are three-lobed, the lobes three-notched at the ends, and with rounded hollows between the lobes and notches.

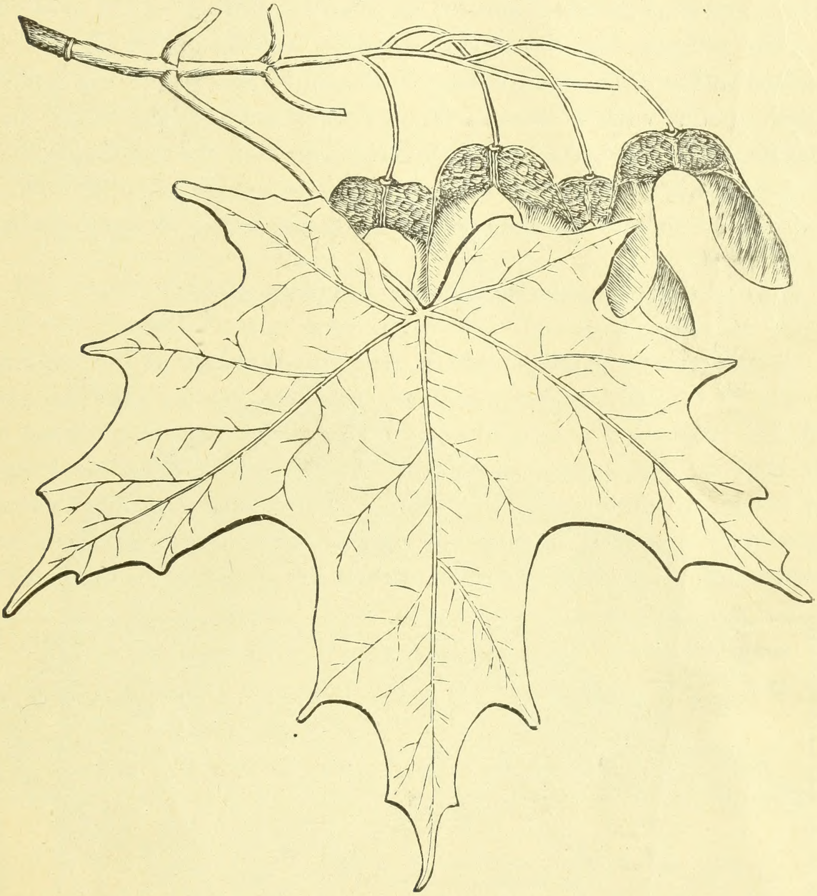

Fig. 2. LEAF AND SEEDS OF THE SUGAR MAPLE.

The twigs are brownish, and the small, sharp-pointed winter-buds are of the same color. The flowers appear in greenish clusters with the leaves, and the fruit ripens late in the fall. (See Figs. 1 and 2.)

The *red maple* has its bark broken into layers looser and narrower than those of the sugar maple. The leaves have three to five sharp-pointed lobes, with sharp hollows between the lobes, and are white on their lower surface. The twigs are frequently bright red, and the conspicuous, round winter-buds are always of that color. The flowers appear in early spring before the leaves, in short, bright red or yellow clusters along the twigs, and the fruit, ripening in July, sprouts at once on falling to the ground.

The *striped maple* or moosewood (or swamp dogwood, as it is called in the higher mountains) is a small tree rarely ten inches in diameter, with a smooth striped bark on both the trunk and branches. The leaves are shaped like those of the red maple, but are larger and are green beneath. The twigs are purplish with a white bloom, and the long winter-buds are borne on stout stalks.

DISTRIBUTION OF THE MAPLES.

Although the sugar maple is frequent throughout the western parts of North Carolina, and eastward as far as Halifax and Wake counties, it is only along the Blue Ridge and to the west of it that it forms extensive groves. To the east of the Blue Ridge it is usually confined to the alluvial bottoms along the streams, generally scattered at intervals among other kinds of trees, or, where the soil and moisture conditions are suitable, forming small groves mixed with a few other species. In most places, however, east of the Blue Ridge the sugar-making season is too short, and warm weather, when labor is in demand for other employment,

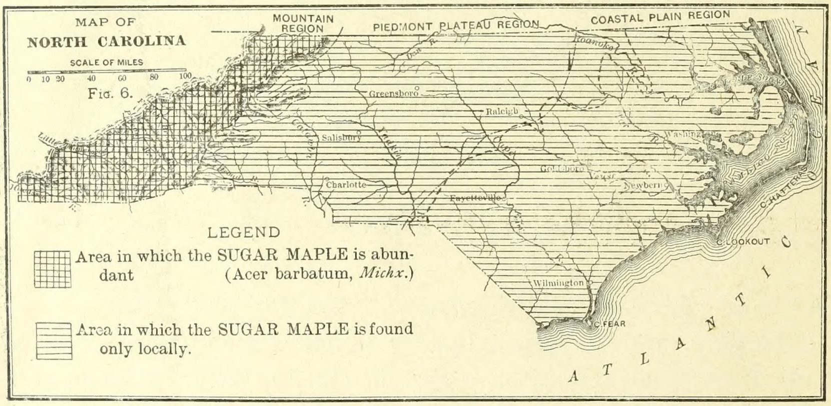
Fig. 6.

begins too soon to offer any inducements for attempting to make sugar or syrup. The tree is most abundant in the extreme northwestern counties, Ashe, Watauga, Mitchell and Yancey, generally growing on the dryer bottom lands or the lower mountain slopes, at altitudes above 3,000 feet; and in similar situations, though less abundantly, it is found as far south as Cherokee county. The red maple has much the same general distribution in western North Carolina as the sugar maple, but is more abundant, especially at the lower elevations. The striped maple is also widely distributed in this region, but is abundant only on the northern slopes of mountains or along streams at elevations above 3,000 feet.

STRUCTURE OF MAPLE WOOD.

The trunk of mature maples, like that of all our common trees, may be separated into four parts: (1) The heartwood, in the

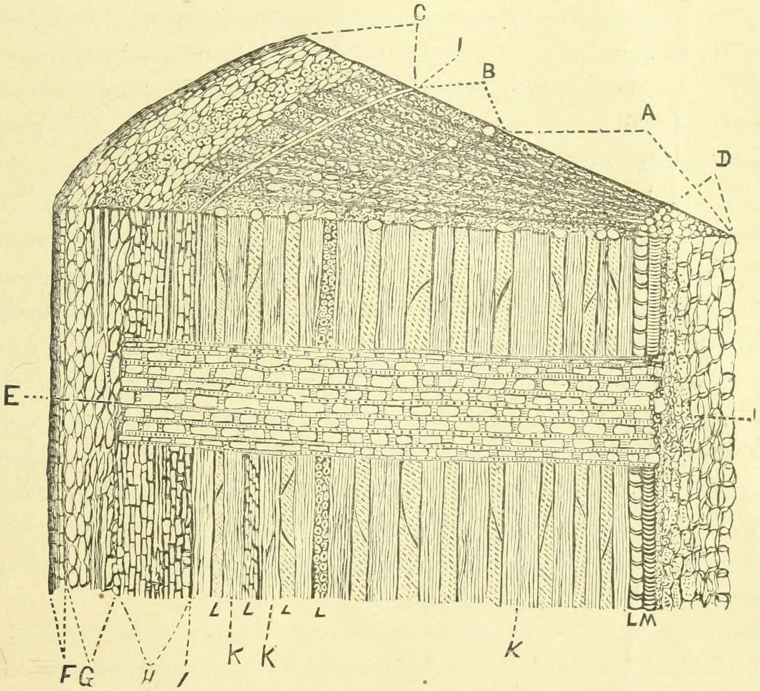

Fig. 3. CROSS-SECTION OF MAPLE TWIG.

D, pith; A and B, woody part of twig; C, growing tissue and bark; F, bark; G and H, growing tissue; E, silver grain; L, ducts in which sap flows; K, strong supporting tissue.

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centre of the stem ; (2) the sapwood, forming from 20 to 35 layers of annual growth around the heartwood ; (3) the cambium or growing tissue, a layer of rather soft wood lying just exterior to the sapwood and just within the bark ; and (4) the bark, forming the fourth and outer layer, which merely serves as a protective covering for the rest of the tree.

The cambium (see G and H of Fig. 3) is the seat of the growth of the tree trunk, as it contains all of the growing tissue. Great care should be taken not to injure this cambium in any way, not to separate the bark from it or it from the sapwood, as, in either case, the sap will run in and fill up the crack and will ferment in it. The fermentation will be communicated to the living cambium tissue and will cause its death. The bark will eventually become loosened or fall off, showing that it is a dead spot. Such dead spots heal over very slowly. Sometimes they never heal, and through them different forms of rot enter the trunk of the tree, and destroy the heartwood, and even the sapwood which contains the valuable sap. Fortunately, though, the sugar maple is attacked by few rot-forming diseases, and is such a rapid grower that it quickly grows over small scars and cuts. The red maple is less vigorous and more subject to disease.

DISTRIBUTION OF THE SAP IN THE TREE.

The greater part of the sap in the maple lies in the outer layers of the wood, chiefly in the sapwood, there being little or no moving sap in the heartwood. There is a greater flow of sap also in the outer than in the inner layers of the sapwood, so that a hole which penetrates 2 to 3 inches in the tree will pass through those layers of wood which contain the most sap and are richest in sugar. The greatest flow of sap is always from holes nearest the base of the tree, so that holes should be put as low down as possible.

Although the flow of sap from a wound is chiefly up and down from the longitudinal ducts, it is also to a less extent horizontal, so that, if two holes be bored near together in the same side of the trunk, they will not run as much as if placed on opposite sides for they will draw sap from the same part of the tree; and for a like reason, a hole twice the size of another will not run twice as much sap as the smaller, in fact only a very little more, since each would draw sap from practically the same sized section of the tree.

There is more sap on that side of the tree which has the largest and most limbs, as that is the side which is forming the most new wood and will require the most nourishment. This side of the tree is usually the south side, and is best for tapping as it will yield the greatest amount of sap. Sap on the south side begins to flow earlier than on the north, as the buds on the branches facing the sun expand before those on the north side. Cutting, boring or otherwise wounding trees unnecessarily should always be avoided, as the sap is for the nourishment of the trees, and the loss of it tends to lessen their vitality and make them less vigorous, though trees will stand a great drain of sap if it be carefully taken, without showing an impairment of strength.

TAPPING MAPLE TREES IN NORTH CAROLINA.

The usual way of tapping maple in the mountains of this State is about the same as was practiced in the more northern states up to thirty or forty years ago. An auger hole, one to two inches in diameter, is bored in the tree several inches deep, often 5 or 6. A piece of elder stem of a proper size, with the pith pushed out so as to make a tube of it, is driven in this hole. This spout, after the sap has ceased running, is usually left in the tree until it decays or some accident breaks it off, often thus preventing the hole from healing up for some years. The sap is caught in a rough trough, 18 to 24 inches long and 6 to 8 inches deep, hollowed from a lin (basswood) or yellow poplar log. It is usually boiled down in evaporators, which are found in general use in this section for making sorghum. In general the syrup being carelessly made is of a dark color, and the sugar is also dark, rarely more than 70 per cent. of it being crystallized.

While this practice is cheap and simple in the extreme, it is very injurious to the trees, very wasteful, and produces a product that is salable only at the lowest prices. The chief injury to the tree is in the large hole which takes many years to grow over, the direct exposure of the sap in the hole to the air, so that it frequently sours there, causing the surrounding wood to die and rot, and "killing" a large spot beneath the hole. The wooden spout often goes in beyond the bark, and covers some of the layers of ducts from which sap exudes, and so prevents these from running, thus cutting off a large part of the sap, which chiefly flows from the outer layers of wood.

Another method, still more rough, is to cut with an axe a deep V–shaped notch in the side of the tree. At the bottom of this notch a stout hollowed chip is driven in for a gutter or spout, and this turns the sap into the accustomed wooden trough. Many of these notches never grow over, and great rotten places in the sides of the trees are the result.

HOW AND WHEN TO TAP.

Tapping should be done with an oval-lipped or smooth-cutting bit, as with this there is less danger of injuring the cambium or growing layer beneath the bark. The hole should not be over one-half inch in diameter, while three-eighths inch is the size most Vermont sugar-makers use. Such a hole, if the spout is removed, will grow over in one or, at most, two seasons. The flow from it is very little less than from a hole twice the size, or even larger. It should vary in depth according to the size of the tree, but should not be over 2 inches deep. Holes should be placed near the ground on the side of the tree with the largest limbs. In large trees two holes can very well be placed so near each other that their spouts will empty into the same bucket.

Trees will run sap after the first thaw following the first hard freeze after the leaves have fallen, and can be tapped any time from then on until the buds begin to swell in the spring.

SAP SPOUTS.

Metal spouts have largely taken the place of the hollow wooden

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spouts, and although they require a considerable outlay at first, yet in saving time and trouble they soon make up for it. They are readily and securely fastened in the holes, and easily drawn out, with little danger of injuring the growing layer beneath the bark. The best forms of spouts prevent the air from reaching the sap in the hole and turning it sour, and keep the sap from drying on the sides of the holes, and so stopping the flow. They are made of galvanized or tinned iron and will last for years.

Two types of metal spouts are to be particularly recommended. One of the "eureka" type (Fig. 4), and the other of the "record" type (Fig. 5.)

The "eureka" spout, which is the size of the figure, is made of galvanized iron. It is held fast in the tree by a strong cross-shaped projection, which, while it enters the hole for some distance and may go beyond the bark, yet covers up only a few of the ducts from which the sap flows. It has either a hook or notches by which a bucket can be suspended. In order to drive it in so that it will not leak, the bark must be smoothed off around the hole.

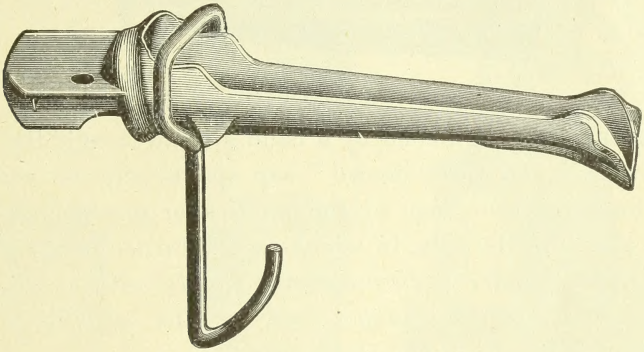

FIG. 4. EUREKA SAP SPOUT.

When the spout is removed before the buds start, the hole will have to be plugged with a wooden plug, otherwise the fermenting sap will sour on the bark, and this acidity will kill a large place upon the tree. If the spout is removed after the leaves start there is no need of plugging, but it should not be taken out too late, else the new wood will have begun to grow over the hole and

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it will be bruised by tearing the spout out. More than 15,000,000 "eureka" spouts have been sold, and they are in very general use in the northern states wherever maples are tapped. They cost about $2. per 100, or with wire hooks as shown in figure 4, about $2.25 per 100.

The "record" spout costs only about one-half of what the "eureka" spout does. "The body of the spout is made up of two distinct spouts, one being placed inside of the other, then dipped in melted solder which welds the whole into one solid piece. The end that is driven into the tree is closed, with the exception of a small hole through which the sap flows, but which at the same time prevents the air from entering the hole and drying the sap in the tree."

They are not so apt to injure the bark as some other spouts when they are pulled out. The bucket can be hung from them either by a hole in the side of the bucket or from a wire loop hung to the spout.

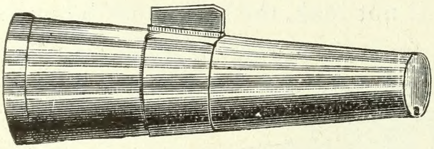


Fig. 5. RECORD SAP SPOUT.

This spout is strengthened by a band around its middle. Both the "eureka" and the "record" sap spouts can be used with buckets hanging from them by the handles, or the buckets can be hung by a hole in the side, in which case a top can be used to keep out the trash. *Under no circumstances should nails ever be driven in a tree from which to hang a bucket.* The sap will leak out around the nail and kill the wood near it.

BUCKETS FOR SAP.

Buckets, suspended from the spouts (see Fig. 7) or from the hooks just below the spouts (see Fig. 4) are now in general use for catching the sap as it runs from the spouts. They are preferably of tin, and should hold about 12 quarts of sap. Sometimes wooden buckets are used. If the buckets are not hung from the spout they should be placed on the ground beneath the spout. *They should never be hung from a nail or iron pin driven in the tree.* They should have a top to them to prevent bark, trash and rain water from falling in them (see Fig. 6), as the bark and trash make the syrup darker, and the addition of water requires more boiling in order to reduce the sap to syrup of the right thickness. Good 12-quart tin buckets such as are here described can be purchased at from $14.00 to $16.00 per 100.

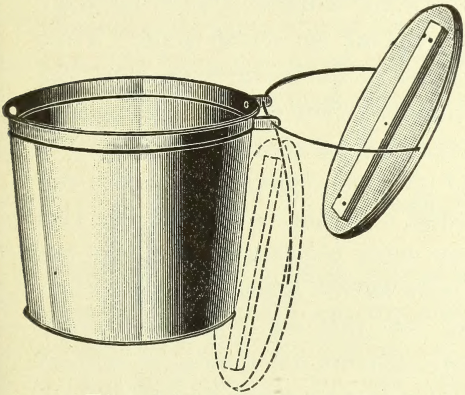


Fig. 6 (*a*). GRIMM SAP PAIL.

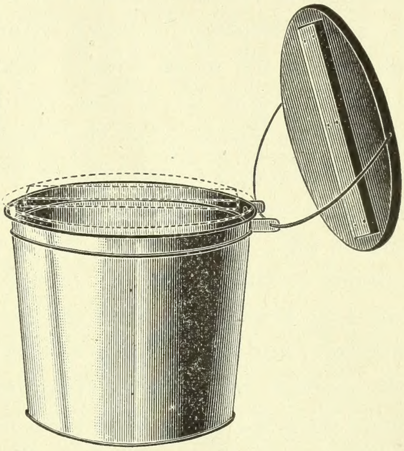


Fig. 6 (*b*). GRIMM SAP-PAIL.

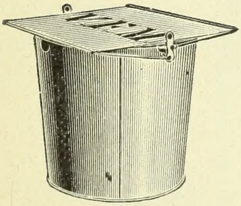
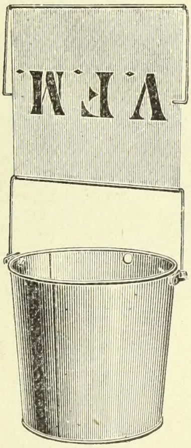


Fig. 6. (*c*) Cover on Pail.



(*d*) Cover Raised on the pail, showing the bail.

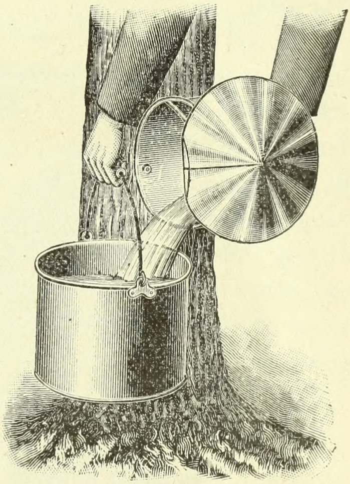


Fig. 7. Cover raised, and cover fastening used as a bail when emptying.

COVERS FOR BUCKETS.

Covers are fastened to the buckets in several ways, but the methods of fastening shown in Figs. 6 are so simple that they are to be recommended. Covers, when not bought, and they can probably be much more cheaply made than bought, should be made of some light wood like yellow poplar or white pine. They should be fastened to the bucket so as not to interfere with the sap spouts, and so as to be easily handled when emptying the buckets, and yet so securely fixed to the buckets that they will not be blown off. One of the points of greatest convenience with the covers is that they can be painted different colors on the two sides, so that by having the same color uppermost on all of the buckets, and turning the covers over as the buckets are emptied, the person who is emptying can tell just which buckets have been emptied and which have not. Covers 12 inches square, of white pine boards, can be made at a cost of from $1.25 to $1.75 per 100.

For convenience of packing in the summer, and of transporting to the trees, and from the trees to the packing house, buckets which will nest, that is slip one within the other, are to be preferred. At the beginning of each season, before being hung, buckets should be scalded out, and once, at least, during the running season they should be rescalded. If the weather turns warm at any time, and any of the sap sours in the buckets, these buckets, after being emptied, should be scalded,as that will remove all trace of the souring, and prevent it being communicated to the fresh run.

GATHERING THE SAP.

Sap should be gathered as soon as possible after it has run, as the earlier it is reduced in the evaporator the brighter syrup it will make and the less apt it will be to sour. Cooke thus describes the best method of gathering sap: "If trees are scattered and some distance from the roads the gatherer should carry two pails; but otherwise more rapid work will be done with a single pail.

When we step up to a tree, if we have two pails we set down the one on the ground in the right hand and with this free hand remove the cover and place it under the left arm; then with the right hand grasp the bucket and swing it on the spout and turn the sap into the gathering bucket, which is held in the left hand. The cover is then placed on the bucket with the sides reversed. Thus the bucket is never removed from the spout, and unless we have two gathering buckets nothing is set on the ground." (See Fig. 7, page 19.)

GATHERING TANK.

The gathering tank should be made of metal, and a very complete form of a metal one is shown in figure 8. This consists of a receptacle with two strainers at the top where the sap is poured in, a coarse strainer on the outside and one with finer meshes below it. At the bottom of the tank is a run-off or exit tube by means of which its contents is transferred to the storage tank at the evaporator. A wooden tank or barrel can also be used for collecting, and instead of the metal and felt strainers, a piece of

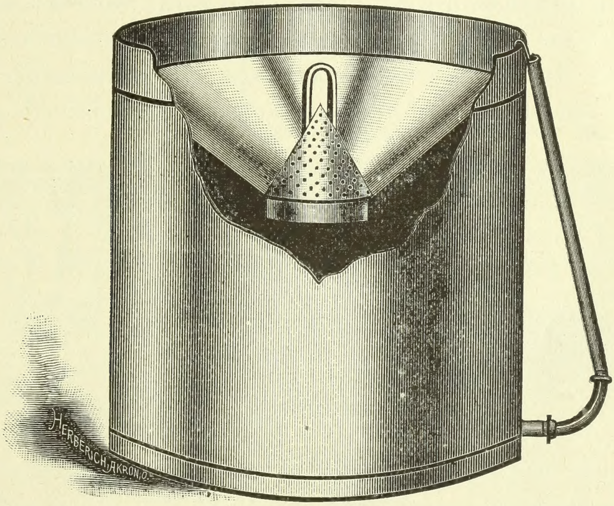

HERBERICH, AKRON, O.

Fig. 8. GRIMM'S SELF-STRAINING AND QUICK-EMPTYING GATHERING TANK.

canton flannel stretched across the top and tacked to the top rim can be used. The sap should always be strained as it is poured from the collecting buckets into the tank, even when covers are used for the sap buckets, to free it from any trash which may have accidentally gotten in. To save time, the collecting tank should always be provided with an exit spout or run-off tube. The tank should be drawn on a sled with a low body so that the buckets of sap can easily be emptied into it, and so that it will be less likely to upset while being drawn along the hill side. These metal hauling tanks hold from 64 to 128 gallons, and cost from $14.00 to $17.00 each. Wooden tanks can be made at a much smaller cost.

THE SUGAR HOUSE.

The sugar house, though not absolutely necessary, is one of the greatest conveniences either where maple products or sorghum is made. Its primary object is to shelter those who are at work around the evaporator during cold and rainy weather, and every evaporator for maple syrup should be placed under a shelter of some sort. In the sugar house is placed the evaporator, which is thus kept out of the rain or snow, and away from trash and dust.

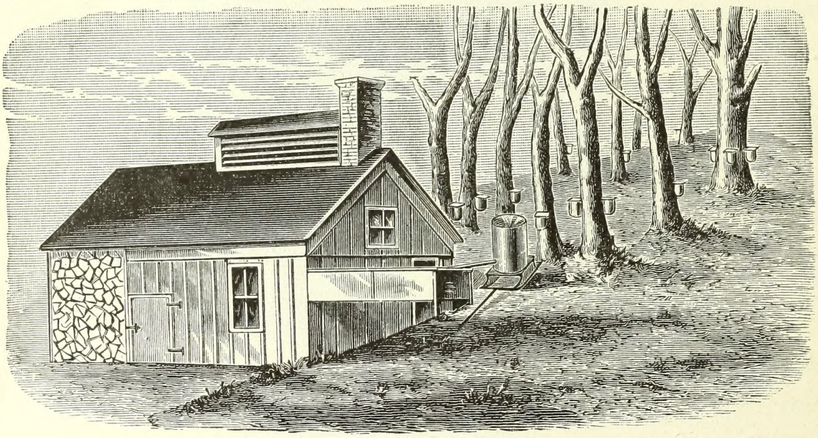


Fig. 9. SUGAR HOUSE.

[Showing the storage tank at the end of the house, and the small cylindrical collecting tank on a sled near by.]

The syrup is here canned, and if sugar is to be made, sugaring off and packing the sugar is done here. Just outside of the sugar house, and preferably on the north and coolest side, should be placed a storage tank for sap. (See Fig. 9.) The sap, as it is brought in from the woods in the collecting tank, should be emptied through the exit pipe into the storage tank. The bed of the wagon road should here be some distance above the bottom of the storage tank so that all of the sap can run from the collecting tank into the storage tank, by means of the exit tube without buckets having to be used. Likewise the bottom of the storage tank should be above the evaporator so that the sap will run from the bottom of the storage tank into the evaporator. The storage tank should be covered and the sap should be strained as it passes from the collecting tank into the storage tank (See Fig. 10). Figure 11 shows an interior arrangement of a sugar house with the storage tank on the inside, the evaporator being a Williams covered evaporator with steam chimney.

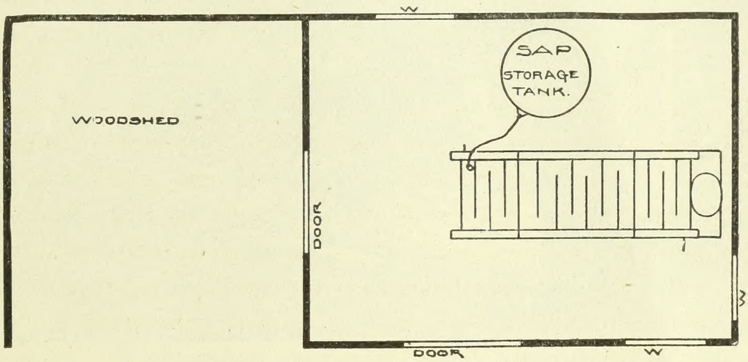


Fig. 10. DIAGRAM OF INTERIOR OF SUGAR HOUSE.

Fuel, which should be cut and piled ready for use some time before, is best kept in a shed or pent house adjoining the evaporator room. It should be under shelter to keep it dry, but if in the same room with the evaporator, the litter and dust from it is likely to get in the evaporator pans.

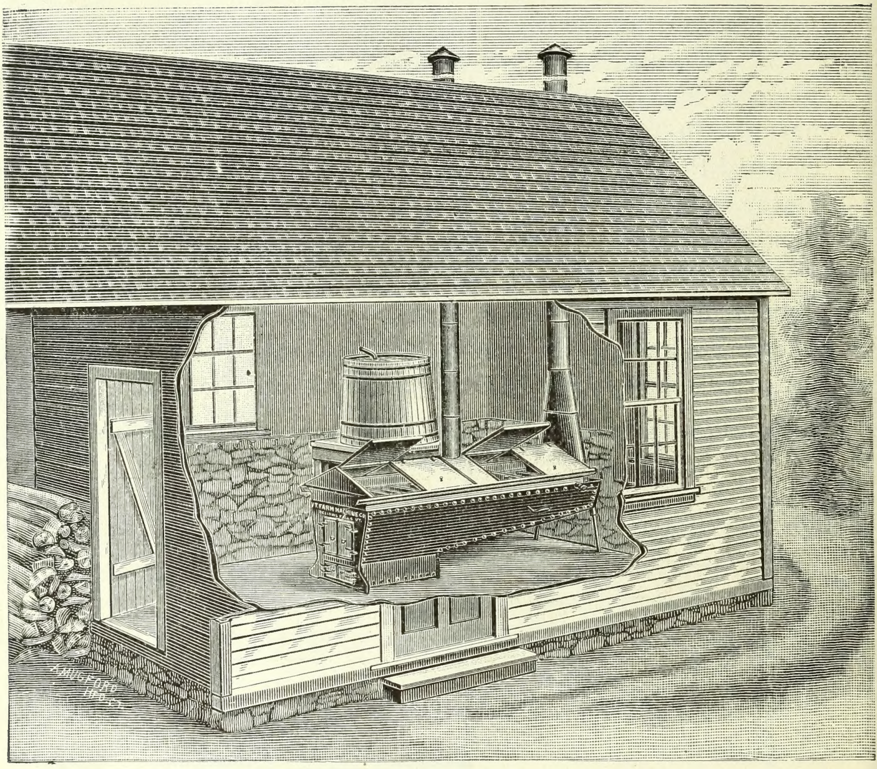


Fig. 11. INTERIOR VIEW OF SUGAR HOUSE.

EVAPORATORS.

Evaporators used for maple syrup are similar to those used for sorghum. They should be placed over stone or metal arches so that a fire can be kept beneath them and a good draught secured, the fuel being put in at one end under the evaporator and the chimney being at the other. Dry wood should be used to give a brisk flame and good heat. As little smoke and dust should be made as possible. The evaporator, no matter what kind, should be set perfectly level, then if the supply of sap flowing in is regulated, there will be no danger of it ever burning. It is customary to have a regulator which, when once set, will regulate the flow of sap from the storage tank into the evaporator. Where large quantities of sap are handled, such a regulator is absolutely

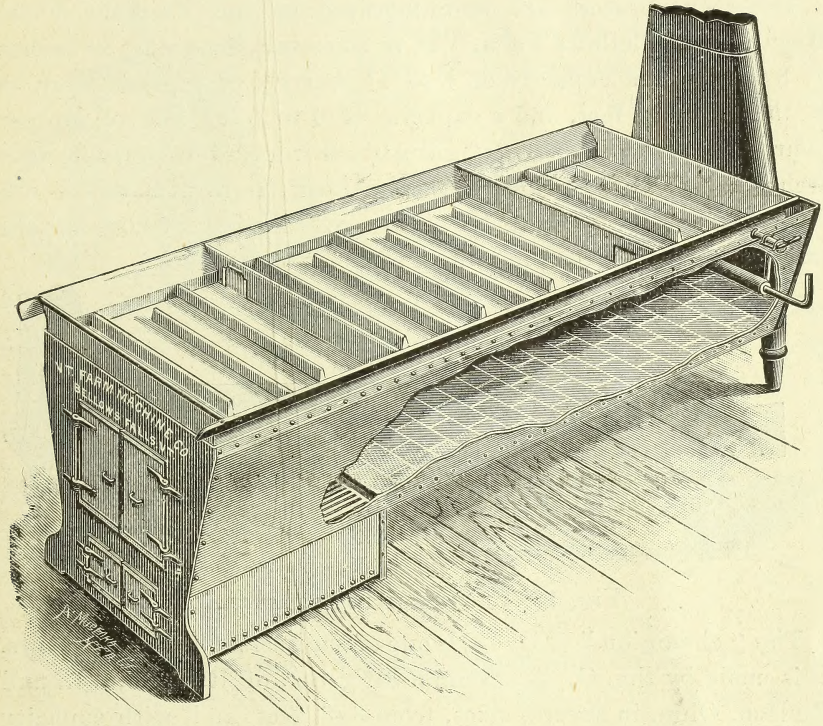


Fig. 12. WILLIAMS BELLOWS FALLS EVAPORATOR.

necessary. With siphon evaporators such a regulator is indispensable to maintain a uniform supply of sap in the first pan, as the siphon automatically carries it from the first pan into the second. The best forms of evaporators are those with corrugated bottoms, which give a greater heating surface. Siphon evaporators have siphons to convey the sap from one compartment of the evaporator to the other. They are automatic and have the advantage of leaving the scum and sediment in each compartment, and not transferring it to the next compartment along with the syrup.

The Williams Bellows Falls evaporator (Fig. 12) requires no siphon, the sap or half-syrup moving evenly through gates or openings in the partitions. The gates in the cross partitions prevent the movement of the scum from one section to another so that most of it can be skimmed off before the sap becomes syrup.

These evaporators are manufactured by the Vermont Farm Machine Co., Bellows Falls, Vt., in sizes varying from 30 inches by 8 feet, and a capacity of ½ to 1½ barrels of sap per hour, to 40 inches by 18 feet, and a capacity of 6 to 8 barrels of sap per hour, costing, when made of galvanized iron and on portable iron arches, from about $60.00 for the smallest size to $120.00 for the largest size; and without the iron arch costing $20.00 for the smallest to $50.00 for the largest size.

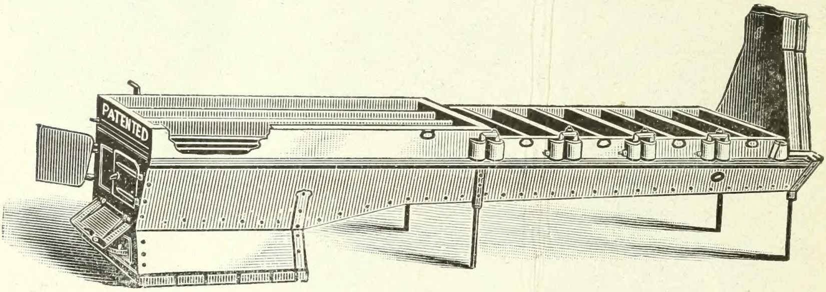


Fig. 13. CHAMPION EVAPORATOR.

The "champion" (Fig. 13) is one of the best siphon evaporators. It is made by the G. H. Grimm Mf'g Co., of Rutland, Vt., and Hudson, Ohio, in several sizes, from 3x8 feet and with capacity for 100 to 150 trees, to 5 by 20 feet, and with capacity for 1400 to 1500 trees.

Regulators are generally used with evaporators to govern the flow of the sap from the storage tank to the evaporator. The "champion" regulator (Figure 14), which is placed in a small pan hung outside the evaporator, regulates the flow by a float, with a lever attached, which rises and closes a valve when the liquid has reached the desired depth.

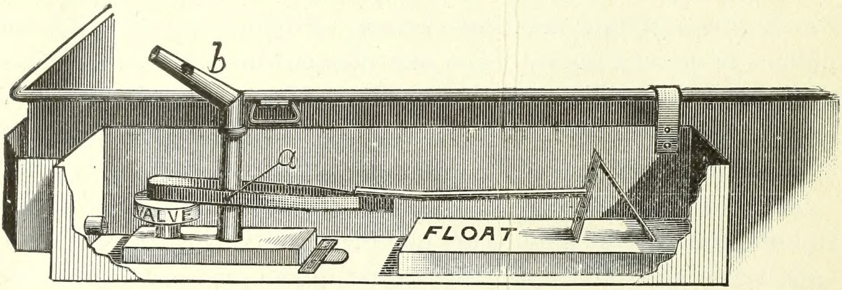


Fig. 14. CHAMPION REGULATOR.

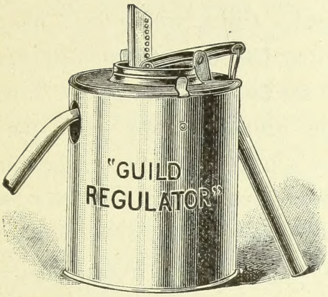


Fig. 15. GUILD REGULATOR.

Figure 15 shows the Guild regulator. "This regulator is set in the front end of the evaporator. A rubber hose, leading from the store tub to the evaporator, is passed through the jaws in the regulator. These jaws are connected to a float which rises and falls as the liquid rises and falls in the pan, opening and closing the jaws as it moves down or up. It never fails to work, if properly set, and is a very great convenience, as it allows the operator to gather sap near by or go to his meals, etc., etc."

With either regulator there is absolutely no fear of burning the pan or syrup, if the store tub (or storage tank) is kept supplied.

MAKING SYRUP.

If the reducing pans are regular evaporators the sap, on beginning, should be turned in to a depth of 1 to 1½ inches, never sufficiently deep to cover the corrugations, and it should be maintained at this depth to prevent any danger of burning. As the syrup boils and become thick it changes from being nearly colorless to a straw color. If syrup is to be made for sale it should weigh about 11 pounds to the gallon when cold. From time to time, after the syrup begins to thicken, a gallon can be drawn off and if it weighs 10½ pounds while hot, it will weigh 11 pounds when cold. A careful observer can soon tell by the appearance, without weighing, when the syrup is thick enough to be drawn off. In open pans where there is no automatic flow, the syrup must be carefully watched lest it become too thick and burn. Iron furnaces are sold to go with some of the evaporators, and these have dampers so that if there is any danger of the syrup burning, the damper can be turned up and the heat cut off.

The hot syrup as it is drawn off must be strained through flannel to remove the malate of lime, "nitre" or "sand" and

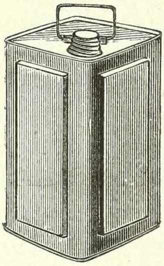


Fig. 16. Syrup can with 1-inch screw cap.

other impurities. It should then, while yet hot, be put in cans (see Figure 16) or quart bottles, which should be tightly sealed while hot. The flannel strainers should be cleaned after each use, and washed after each day's use. Where common pans and not evaporators are used, the syrup should be drawn off three times a day in order to secure a bright colored syrup. Some evaporators must have their bottoms scraped frequently in order to free them from the malate of lime, but in the "champion" evaporator this is prevented from forming by merely regularly shifting the order of the pans. In the improved Williams evaporator the same thing is accomplished by reversing the evaporator and thus causing the current of sap to run in the opposite direction.

The following rules and methods to be observed in making, canning and marketing maple syrup, read by Mr. T. B. Barney before the Vermont Sugar Makers Association at Rutland, Jan. 13th, 1897, are so clear, and have been so highly approved, that they are reprinted here as follows:

> Secure, if possible, an orchard with a southerly inclination, a gravelly or clay soil, with fair sized trees, having a lively, light colored bark, and white wood. Procure the very best evaporators, of a size large enough to boil away your sap as fast as it can run. Have the best of buckets, covers, spouts, holders, a small arch and pan for reducing your syrup, and in fact, all of the most improved apparatus for a first-class sugar works.
>
> Have everything neat and clean to commence with, and then be sure to keep them so. Prepare a full stock of wood the year beforehand. A mixture of soft and hard wood is best; the soft wood will produce a quick blaze, while the hard wood will serve to steady the fire, and make it last well. Have the wood well split, do not think you can boil just as well with large logs and chunks; these do not dry through well, and it is the quick, lively fire you want, and not coals in large quantities. There is as much of "nack" in firing an evaporator correctly, as in firing a locomotive so that it will produce a rapid and steady motion.
>
> Tap your trees where the wood is perfectly sound and light colored. Have good buckets with covers well adjusted, so that they will not blow off. They will keep out the storm and particles of bark and other things that would otherwise color the sap, and will pay for themselves in any three average seasons.
>
> Always be on hand in season to gather your sap as soon as it runs. Do not wait for your buckets to get nearly full before you commence. Strain

the sap before it goes into the holders. Boil immediately and get into syrup as soon as possible. Strain and settle the syrup thoroughly. Do not mix hot and cold syrup. Guage your regulator so that the sap will be only about one inch in depth in your evaporator while boiling, skim it every few minutes. Boil rapidly and when it comes to ten pounds weight to the gallon, in the last partition of the evaporator, draw it out in small quantities and strain through a good *felt* strainer. When you have a sufficient quantity put it in your small pan and bring it quickly to a temperature of 219° which will make it eleven pounds to the gallon when cold. When it comes to 219° the " nitre " will settle to the bottom of the pan ; it should then be stirred up and all put in a good tin settling can having a faucet about two inches from the bottom. Let it stand until cold, then draw off carefully down to the nitre. See that you do not allow any nitre to run out with the syrup.

This completes the necessary rules to be observed in making syrup, and we will now proceed to the canning process. The only safe way to can syrup, if you would have it keep perfectly in any climate[1], is to heat it and mix with it the whites of eggs beaten up in water, (the white of one egg in one-half pint of water for ten gallons of syrup.) When the syrup arrives at the boiling point, *skim* and *strain* it through a good flannel strainer. It is then ready to can and should be put up while hot. The best style of package for a nice retail trade is a solid quart bottle having a screw cap containing a cork. If it is put up for customers who use larger quantities at once, a good heavy tin gallon or half gallon can, well soldered and of the oblong square shape, makes a very nice package.

If one wishes to dispose of his syrup in large quantities without the trouble and expense of canning, it may be put up in good new iron-hooped barrels, holding about 50 gallons, and sold to dealers who make a business of canning for the retail trade.

In order to succeed well in making, canning and marketing your syrup, you must study all these rules and methods carefully, must get them thoroughly fixed in your mind, and then adhere strictly to them. Cleanliness, dispatch and business ability will give you success[2].

MAKING SUGAR.

When the sap has been boiled to such a thickness that it would make a good syrup, it should be poured from the evaporator into the sugar pan and at once reduced to sugar. " Many experienced sugar-makers recommend that the hot syrup be strained through flannel cloth and then allowed to settle until partially cooled before pouring it into the sugar pan, as this settling removes much of the malate of lime from the sugar. In boiling, care must be taken not to burn the syrup. Thick syrup moves sluggishly and hence is liable both to burn and to boil over. A slow fire toward the last is all-important. When the liquid begins to pout, that is, to gather in large air-bubbles, and break with a labored puff—a sort of mild explosion—then it is about ready to be removed." To reduce to "barrel sugar" it should certainly be boiled until the temperature of the boiling liquid is 230° F. When the syrup is about thick enough to sugar it will form, if some of it is dropped from a spoon, delicate threads hanging from the spoon. To make "cake sugar" the syrup should be boiled still longer, until it reaches a temperature of 242° F.; and to make "stirred sugar," longer still, until the temperature is 252° F. In making cake sugar, which is the most desirable for marketing, the syrup is run into moulds (see Fig. 17) and allowed to crystallize out in them; in stirred sugar the syrup is stirred until it cools and crystallizes.

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[1] This applies to syrup that is to be sent to hot climates, and this egg treatment may be safely omitted for all syrup made for consumption in Western North Carolina, if the sap and syrup have been strained and every thing kept neat, as directed. The main object of adding the white of eggs is to gather together the last vestiges of impurities in the syrup which, along with the egg, can be removed by a final straining just before the syrup comes to the boiling point.

[2] Proceedings of the Fifth Annual Meeting of the Vermont Sugar Makers' Association, held at Rutland, January 13 and 14, 1897.

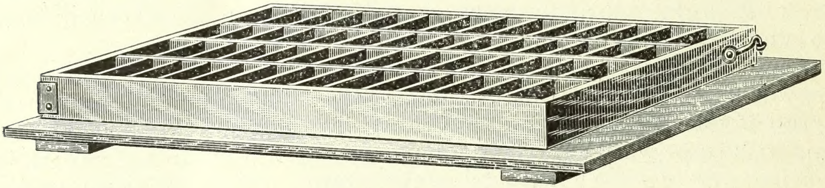

Fig. 17. MOULD FOR MAPLE SUGAR.

Sugar pans or sugaring-off pans, as they are often called, *i. e.*, the pans into which the syrup is poured after having been boiled in the evaporators when it is desired to make sugar, can be obtained from any one of the dealers or manufacturers mentioned on page 34. Those pans made of galvanized iron and adapted for use on a brick arch are priced at about $4.00 for the smaller and about $6.00 for the larger size. Those for use on iron arches, are priced at about $10.00 for the smaller, and $14.00 for the larger size, this including also the additional iron arch necessary for attaching the pan to the evaporator. Special thermometers for determining the temperature to which the syrup shall be boiled for sugar, can be obtained from either of the dealers mentioned on page 20, at from $1.00 to $1.50 each ; but any reliable thermometer which will register as high a temperature as is required can be used for this purpose.

PREPARING PRODUCTS FOR MARKET.

The change from the wooden spout and the open kettle has been brought about by the demands of the public for a lighter colored and more uniform class of syrup and sugar than was possible with those implements. In order to make goods of any kind and find profitable sales for them, they must be what the consumers prefer, and must be cleanly prepared and attractively displayed. The use of buckets with covers, and the frequent straining of the sap and syrup, are necessary in order to keep out dust, fragments of leaves, sticks, bark and other impurities, thus to secure light colored products. Unless the products are light colored, it may be supposed that this dust and trash have not been kept out or that the products have in some other way been adulterated, and they will not command so high a price. If, on the other hand, the sugar and syrup have too light a color one may suppose that they have been adulterated by the addition of ordinary white sugar. The cakes of sugar should be light colored and packed in clean boxes. The syrup should be light colored and should be put up in bottles, tin cans, kegs or barrels. What ever vessel is used it must be absolutely clean. (See directions on pages 28 and 29, above.) The maker should in every case have a printed or written label pasted on the bottle or can containing the syrup, or box containing the sugar, giving his name and address, and stating that the syrup or sugar was made by him and is warranted pure.*

Whenever possible, sales should be made directly to the consumers. Syrups are used in large quantities by hotels, and sales can generally be made directly to them. If the syrup is pure and neatly put up, and if the character of the syrup made is kept uniform each year, there is no reason why a customer once secured should ever be lost. It pays better to make syrup than sugar, as a gallon of syrup as syrup is worth more than if it were reduced to sugar. Syrup retails to the consumer at about 80 cts. a gallon, though some makers claim to realize as much as $1.25 a gallon for all the syrup that they can make. These, however, make an exceedingly light colored, pure and uniform article.

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*See also Notes on page 29.

Most Vermont farmers regard the sugar orchard as one of the best paying parts of the farm.

CARE AND ENLARGEMENT OF SUGAR ORCHARDS.

The most fitting place for the location of the sugar orchard, as a grove of tapped maples is called, is where the maples are most abundant and where a great many occur over a small area. If the orchard can be conveniently located near the farm house, so much the better. A hillside sloping southward is the best place, as trees on a slope which faces the sun begin to run earlier in the season and the running of sap each day will be longer, the trees thawing out earlier in the morning and freezing later in the evening. As trees require a number of years to grow, a place should be selected with a view to permanency, if the orchard is to be enlarged by transplanting or from seed. Land that is too rocky to cultivate, or even too steep, can well be stocked with maples; and the orchard can be permanently maintained in such places as there would be no reason for clearing the land.

There are few places in the forest where as many as one-fourth of all the trees will be found to be maples, and, generally, the proportion of maples over any considerable area will be found to be very much less than this; but if such a place is selected where maples are naturally abundant, showing the soil suited for their growth, the number of trees can be largely increased by planting out young specimens or by allowing maple seed to grow where they fall. In either case the trees other than maples must be removed, or at least thinned out, to give the young maples plenty of light. There is very much to be gained by thus concentrating the maples on a small area and increasing the number above what it was in the original forest, as the labor and time involved in going from tree to tree to place the spouts and buckets, and particularly in emptying the buckets and hauling sap to the evaporator, is much lessened ; trees, too, are much less apt to be overlooked and passed by than if sparsely scattered among other trees.

To increase the number of trees by transplanting, small maples can be dug up from places where they are found to be numerous and set out in the orchard, and such transplanted trees will, of course, become large enough to tap much sooner than if they were allowed to grow on the spot from seed. Maples when fifteen years old, if the growth has been kept open and there has been sufficient sunlight to enable them to grow vigorously, are large enough to have one small spout put into them. In transplanting trees, vigorous and healthy young trees are to be selected, and it is advisable to plant only sugar maples. They should not be too large, as the cost of handling large trees is very great. They should be dug up, care being taken not to injure the roots and to cut off none where it is not absolutely necessary. In trimming the top, to reduce the limbs to correspond to the reduced number of roots, the leading central shoot should not be cut off, as trees thus mutilated, especially if they are large trees, are apt to have black streaked wood and generally, sooner or later, hollow trunks. Limbs should be smoothly cut off without tearing the bark away from the wood.

Even if all of the trees in the orchard are maples, they should never be crowded, as when far apart they have large heads and an abundant supply of sap. The tops or crowns of the trees should not touch each other, and young trees, as they grow up and their tops begin to interlace, should be thinned out, the smaller and less vigorous specimens being removed.

The evaporator, and the sugar house, if there is one, should be located in the center of the orchard, or as near the center as possible, as the sap will then have to be transported less distance from the trees. If, however, the maple trees of the orchard are distributed over a continuous slope it will be found more convenient to have the sugar house at or near the bottom of the slope.

DEALERS IN OUTFITS FOR MAKING MAPLE PRODUCTS.

Outfits for making maple sugar and maple syrup can be obtained from the Vermont Farm Machine Co., Bellows Falls, Vt.; or from the G. H. Grimm Manufacturing Co., Rutland, Vt.; or the Champion Manufacturing Co., Columbus, O.

LIST OF BOOKS CONSULTED.

Emerson's Trees and Shrubs of Massachusetts.
Bul. 26 Vt. State Ag. Ex. Station, Maple Sugar.
Bul. 30 Vt. State Ag. Ex. Station, Results of bounty on maple sugar.
Maple Sugar, by A. J. Cook; published by A. I. Root, Medina, Ohio. This is an excellent explanation of the best ways to make sugar and syrup, and should be owned and referred to by persons in this State interested in sugar making. It has been largely used in the preparation of this paper. Price by mail, 40 cts.
Goodale, Physiological Botany.
Rept. of Mass. Board of Agr., 1874.
Proc. of A. A. A. Science, 1879.
Bul. 5 of the Chemical Div. of Vt. Dept. of Agr.
Trans. of Royal Soc. of Can., Vol. V., Sec. III. (1887).
André, in Revue Horticole, 1886, p. 284.
Studies of Maple Sap, Bul. 2, N. H. Agr. Ex. Station.
Bul. 25, N. H. Agr. Ex. Station.
Several articles in Garden and Forest, New York.
Publications of Vt. Maple Sugar Maker's Asso.
Forests of Vt., H. A. Cutting.
Catalogue of Vt. Farm Machine Co., Bellows Falls, Vt.
Catalogue of the G. H. Grimm Mfg. Co., Rutland, Vt., and Hudson, Ohio.

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1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map ..... Postage 10 cents.

2. Building Stone in North Carolina, by Joseph A. Holmes and J. Volney Lewis ..... In preparation.

3. Gold Deposits of North Carolina, by Henry B. C. Nitze and Geo. B. Hanna, 1896. 8°, 196 pp., 14 pl., and map ..... Postage 8 cents.

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp ..... Out of print.

5. The Forests, Forest Lands, and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl ..... Postage 5 cents.

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe ..... In press.

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12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes ..... In preparation.

13. Clay Deposits and Clay Industries in North Carolina, by Joseph A. Holmes and Heinrich Reis ..... In preparation.

14. Mica Deposits and Mica Mining in North Carolina, by Joseph A. Holmes ..... In preparation.

15. Mineral Waters of North Carolina, by F. P. Venable ..... In preparation.

16. A List of Elevations in North Carolina, by Joseph A. Holmes ..... In preparation.

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology and Mineralogy, by Joseph A. Holmes ..... In preparation.

18. Road Improvement in North Carolina, by J. A. Holmes and Wm. Cain ..... In press.

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NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 2

SOME
RECENT ROAD LEGISLATION
IN
NORTH CAROLINA.

J. A. HOLMES

The result of one hundred years of road building under the old system of compulsory labor. Isn't it about time to try a different system?

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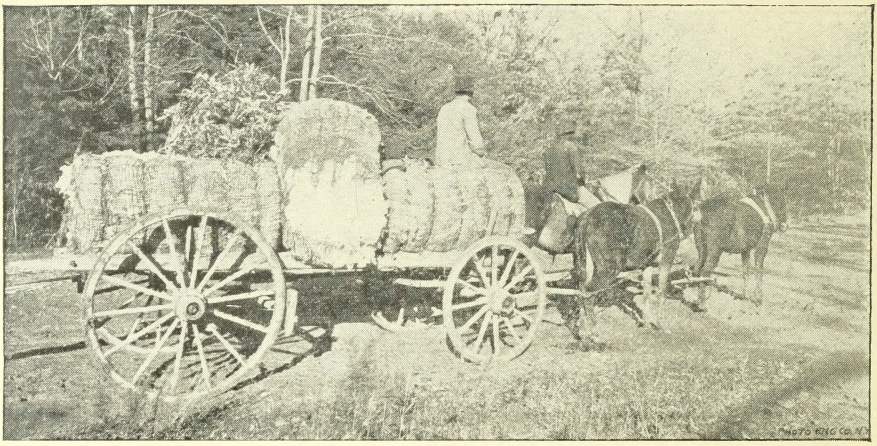
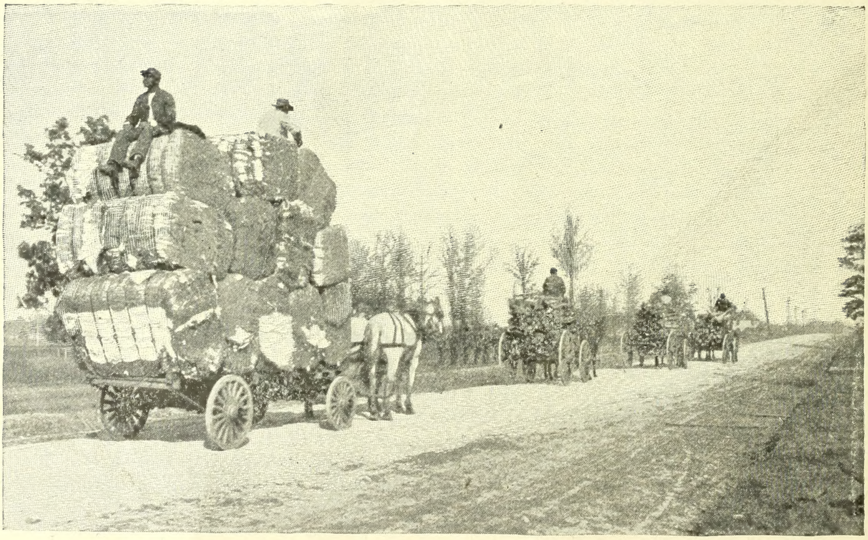


The old fashion earth road may be the cheapest road to build but it is the most expensive road to use. In using them we lose more than it would cost to build good roads.



The people of Mecelenburg invested during 1898 over $40,000 in these good roads, and they say this is the best paying investment the county ever made.

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LETTER OF TRANSMITTAL.

To his Excellency, HON. D. L. RUSSELL,
Governor of North Carolina.

SIR :—In response to a somewhat general demand for the same I have the honor to submit for publication, as the second of a series of *economic papers*, a brief account of some recent legislation in North Carolina providing for the maintenance and improvement of the public roads and highways in certain counties in the State.

Yours obediently,
J. A. HOLMES,
State Geologist.

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PREFACE.

Many a legislator has returned to his home with the feeling that having passed a new road law for his county the securing of good roads is only a matter of a short time. But during the next few years he has seen his law either repealed or amended, for better or worse, by succeeding legislatures; and meanwhile little or nothing has been accomplished in the way of improvements of a permanent character. But the very rapidity with which local road legislation has changed in North Carolina during the past decade of itself indicates in a measure the deep interest felt by our people in this subject.

There are many people who seem to think that a good road law will make good roads; but we all realize after a short experience that this will be true only when such a law is supported and executed by an intelligent and progressive public opinion and action. In a community guided by such a sentiment there is needed only a law which, in the simplest possible way, gives the proper authorities the power to do what is right and necessary in this connection.

The general road law of 1899 published in this paper is not the product of any one person. It was prepared by and under the direction of the public roads committee of the last General Assembly. It is based on the experience of the best road builders in the state and a careful digest of existing road laws in this and other states. Not one of its authors supposes it to be perfect or that the law of itself will build good roads; or that it will please everybody; for there are many people who do not like any law which levies a tax and says "thou shalt" do even what they know must be done. But it is believed that a careful examination and test of this law will show it to be greatly helpful in any county or township where the people have determined to permanently improve their public roads whether they be located among the mountains or nearer the sea shore. In Bulletin 18 of the Geological Survey series of reports will be found a fuller discussion of road legislation in North Carolina during the past century, and also a description of the modern methods of road building.

SOME RECENT ROAD LEGISLATION IN NORTH CAROLINA.

LAWS OF A GENERAL NATURE.

Among the laws in relation to road building in North Carolina enacted by the last Legislature there are a few of a somewhat general nature which owing to the new features which they embody or to their general application deserve to be mentioned in this connection. Of these the general road law, which is published in full below (p. 11), applies directly to only a limited number of counties; but any of its sections except that levying a tax may be adopted by any county otherwise providing funds for road improvement. The wide-tire law, the object of which is to encourage the use of wide tires on wagons and other draft vehicles, applying to eleven counties and one township, is also published in full below (p. 24). Two general acts relative to public prisoners were passed: one authorizing the Commissioners in the several counties to provide for working all short term prisoners on the public roads or on county farm; the other, "An act to compel vagrants to work on public roads or highways of the State." Another act provides that persons having gates on public roads shall provide hitch-posts on either side of the gate.

SPECIAL OR LOCAL ROAD LAWS.

A considerable number of local laws were enacted bearing on the subject of road and street improvements in different counties and towns. Five counties and one township were authorized to vote during the present year on the issue of bonds for road purposes: Alamance, Cabarrus and Mecklenburg, for $100,000 each; New Hanover, for $50,000, and Anson for $25,000; Monroe township (Union county), $30,000; and several other counties were authorized to issue bonds for the building of bridges. Beside these, some half dozen towns were authorized to vote bonds for street improvement.

New special road laws were enacted for Anson, Washington, New Hanover, Cumberland, Davidson and Polk; special laws relative to the use of convicts were passed for Franklin, Chatham, Robeson and perhaps a few other counties; the existing laws with reference to the working of convicts on the roads in Anson county and the working of public roads in Graham, Transylvania, Jackson, Guilford, Haywood, Mecklenburg and Wake were amended; while special laws for Northampton, Green, Wilson, Wayne, Nash, Halifax, Jones, Ashe, Alleghany and Watauga were repealed. In addition to the above a number of special laws were enacted with reference to the construction of bridges, ferries and turnpikes in various counties.

THE GENERAL ROAD LAW OF 1899.

The Mecklenburg road law, which was the beginning of modern road legislation in North Carolina, was drawn by Capt. S. B. Alexander of Charlotte as a general road law, but was adopted by the General Assembly of 1879 for only 3 counties, Mecklenburg, Forsyth and Stokes. It was repealed by the following Legislature (1881) for each of these counties. It was re-enacted by the General Assembly of 1885, in a somewhat modified form, for Mecklenburg county alone. Since that time it has entered largely into the road legislation for various counties. Indeed this has exercised a lasting influence for good on the road legislation of the state. The general road law of 1899 is intended to serve either as a supplement to this Mecklenburg law or as a substitute for it. It is more especially a county system of road management, while the Mecklenburg law is more especially a township system. It may be made to serve as a substitute for both this Mecklenburg township system and for the general convict law, under the latter of which in Mecklenburg county that splendid system of Macadam roads has been constructed during the past few years.

PRINCIPAL FEATURES OF THE LAW.

The principal features of this law of 1899 may be stated as follows:

Section 1 provides for a tax levy for road purposes by the County Commissioners of not less than 5 nor more than 25 cents on the $100 worth of property, nor less than 15 nor more than 75 cents on the poll, the funds arising from this tax to be used as far as possible for permanent improvements.

Sections 2 and 3 provide for the appointment of either a superintendent of roads, or township road supervisors, or both, to take charge of the road work under the County Commissioners.

Sections 4, 5, 6, and 7 provide for the repairs or patching of public roads by able bodied male citizens between the ages of 21 and 45 years, four days labor or the payment of $2 for each man.

Section 18 empowers the Board of Commissioners to gradually reduce the number of days of labor required for road duty, one day for each year, until the old labor system is abolished entirely, the road tax being increased proportionally; while Section 19 empowers the Commissioners to reduce the payment in lieu of this labor from $2 to $1 per annum when a sufficiently high tax is levied.

Sections 8 and 9 provide that any county shall work on its poblic roads all its prisoners whose sentence does not exceed 10 years; and that it may also use similar prisoners from other counties in the same or adjoining judicial districts; also that counties with but few convicts may arrange for an exchange with neighboring counties.

Sections 10 and 12 provide for the proper grade, width and relocation of important public roads or highways. In changing the location of roads to avoid hills, etc., the location of the road is first changed; and if after the new road is completed damages are claimed the benefits and damages are both considered by an impartial jury and settlement made on this basis. Section 10 recognizes and separates these principal public roads or highways which are to receive this special treatment from the less important roads which may receive less careful attention; the selections to be made by the county commissioners.

Section 11 provides for obtaining timber, stone, gravel, etc., from unimproved lands adjacent to the roads.

Sections 15 and 16 make the county treasurer also treasurer of road funds and provides for the disbursement of these funds.

Section 20 provides that counties levying bonds for road purposes need not levy a road tax in addition.

Section 21 provides that any township may by a majority vote or petition have levied a township road tax in addition to the county road tax.

Section 22 makes this act apply to the following counties: Mecklenburg and Forsyth (except sections 4, 5, 6 and 7); Alamance, Durham, Rockingham, Gaston, New Hanover, Pender, Warren, and Chapel Hill township of Orange county.

Section 23 provides that this act may be adopted as the road law for 39 additional counties or any township therein by the Board of Commissioners, when petitioned so to do by 300 freeholders in the county or 50 freeholders in any township.

Sections 24, 25 and 26 relate to Durham, Pender and Orange (Chapel Hill township) counties respectively.

Section 27 provides that in any county not coming under the provisions of this act but otherwise providing funds for improving its roads, the Commissioners may nevertheless adopt as a part of the road law of their county any sections of this act except Section 1, levying a tax. In this way this new road law may be in part adopted by every county which is earnestly trying to improve its public roads.

Section 28 repeals all laws or parts of laws in conflict with this act and Section 29 makes this act in force March 7, 1899.

A careful examination of this law will show that it is in a measure both flexible and rigid, and hence that it can be easily adapted to the varying conditions which exist in different portions of the State.

COUNTIES TO WHICH THE ABOVE LAW APPLIES.

As will be seen from an examination of section 22, the general road law of 1899 is made to apply directly to nine counties and one township. Section 23 states the conditions under which this law may be adopted for thirty-nine additional counties.

Section 27 gives a list of counties to which the law does not apply but also provides that any or all portions of the law (except section 1 levying a tax) may by a vote of the county commissioners be incorporated as a part of the road law of any county in the state otherwise providing funds for road improvement. In this way it is possible for the best features of this law to be adopted by every county in the state which is making a serious effort to improve its public roads.

AN ACT TO PROVIDE FOR THE BETTER WORKING OF THE PUBLIC ROADS AND HIGHWAYS OF THE STATE.

The General Assembly of North Carolina do enact:

SECTION 1. That the board of county commissioners in each of the several counties coming under the provisions of this act, shall, in order to provide for the proper construction, improvement and maintenance of the public roads of the county, at their regular meeting in June, 1899, and at each regular annual meeting thereafter, and it is hereby made their duty to levy a special tax on all property subject to taxation under the State law in said county of not less than 5 cents, nor greater than 25 cents on the $100 worth of property, and not less than 15 cents nor greater than 75 cents on the poll; the constitutional equation to be observed at all times; said taxes to be collected as all other taxes are, to be kept separate in the tax books of the county, to be set aside as a special road fund to be used in the construction, improvement and maintenance of the public roads of the county, the purchase of such material, implements, teams, wagons, camp outfit, quarters or stockades, for the use of and safe keeping of the convict force as may be found necessary in the proper carrying out of this work, and for the employment of such additional labor as may be deemed necessary: *Provided, however*, that the moneys raised under this section shall, as far as possible, be used for permanent improvements.

Provision for a road fund.

Money to be spent for permanent improvements.

SEC. 2. That there shall hereafter be elected by the board of county commissioners at their regular meeting in June, 1899, and at their regular meeting in January of each and every year thereafter, a superintendent of roads, who shall be paid such compensation as may be fixed by the board of county commissioners, and to be paid out of the county road fund, and who, after January, 1899, shall hold office for one year, or until his successor has been elected and qualified, as provided for in this act: *Provided*, that the said superintendent of roads may be at any time removed by the board of county commissioners after having been given ten days' notice and a hearing, when in the opinion of the board there exists good and sufficient cause for such action; and for malfeasance or misconduct in office he may be removed by them without further notice than may be necessary in order to give him a hearing. It shall be the duty of said superintendent of roads, subject to the approval of the board of county commissioners, to supervise, direct and have charge of the maintenance and building of all public roads in the county, and he shall submit to the board of county commissioners a monthly report concerning the work in progress and the moneys expended; and he shall submit quarterly a report on the condition of the public roads and bridges, and plans for their improvements, and he shall include in this quarterly report an inventory of the tools, implements, teams and other equipments on hand. Said road superintendent, before entering upon the duties of his office, shall deposit with the board of county commissioners a good and lawful bond, to be approved by the said board of commissioners, for the sum of $2,000 as a guarantee of the faithful and honest discharge of the duties of

Constant and responsible oversight of roads.

Bond of the road superintendent.

North Carolina
State Library.

his office, which bond shall be duly registered in the office of the register of deeds and filed with the clerk of the superior court of the county. In case of the death or resignation or removal of said road superintendent, it shall be the duty of the county commissioners to elect at their first meeting thereafter a road superintendent, who shall hold office at the discretion of said board of county commissioners, or until the regular January meeting of said board, and until his successor has been elected and qualified: *Provided*, that when in the opinion of the board of commissioners in any county coming under the provisions of this act, not regularly employing a convict force on its public roads, the appointment of a road superintendent is inconsistent with the best interests of such county, the said board shall not be required to comply with the requirements of section 2 of this act, but may, in lieu thereof, appoint directly one supervisor of roads in each township, and each such supervisor, in the township for which he is appointed, shall perform the duties and assume the responsibilities in this act otherwise required of the county road superintendent; he shall be subject to dismission under the same terms as laid down for the road superintendent; and he shall give a good and lawful bond, satisfactory to the board of commissioners, for not less than twice the amount of the road tax in his township for any one year, under the same conditions as laid down for said road superintendent, and he shall be paid such remuneration as may be agreed upon by the board of county commissioners.

Appointment of township supervisors.

SEC. 3. That the board of county commissioners, or the road superintendent, subject to the approval of said board, shall appoint, with power at any time to remove or discontinue, such guards as may be needed to take charge of the convict force, and also one or more persons in each township of the county, to be known as township supervisor of roads, who, acting under the road superintendent, shall supervise the road work in the township for which they are appointed, or such parts thereof as said superintendent may direct. The said guards and township supervisors shall be paid for such time as they may be required to give to this work, such compensation, per day, during such time as they are actually employed in working on the public roads as may be agreed upon by said [road] superintendent, and approved by the board of county commissioners, the guards to be paid out of the general county road fund, and the township supervisors to be paid out of the respective township road funds.

Temporary township supervisors.

SEC. 4. That all able-bodied male persons of the county, between the ages of twenty-one and forty-five years, except [residents] of incorporated cities and towns, shall work on the public roads of said county for four days (of nine hours each) in each and every year at such time and place, and in such manner as may be designated by the road superintendent or township supervisor: *Provided*, that the said superintendent or the supervisor in each township shall give to each person of his township, who is subject to road duty, at least three days' notice by personal warning, or by leaving a written notice at the home or residence of such person, specifying in such notice the time and place when and where such work is to be performed, and also designating in such notice the tool or implement with which such person shall be required to work: *Provided*

Four days labor for repairing roads in each township.

further, that in case of washout or other unexpected obstruction to travel the three days' notice shall not be neccessary, and any person liable to road duty in the township in which such obstruction to travel may occur, shall, upon being properly summoned by said superintendent or supervisor of roads, respond to such summons with reasonable promptness: *Provided*, *further*, that any person may, in lieu of working four days on the public road, pay on or before the first day of July, 1899, and on or before the 1st day of April of each year thereafter, to the county treasurer or road superintendent, the sum of two dollars, and it shall be the duty of said treasurer or road superintendent, upon receipt of said money, or any part thereof, to issue to such person a receipt for the same, stating in such receipt the amount and the year for which the same is paid. All moneys paid to the said road superintendent, as provided for in this act, shall, within fifteen days after being received by him, be turned over to the county treasurer and credited to the road fund of the township from which the same was paid, and the same shall be expended in the improvement of the roads in that township from which it was paid. If the road superintendent fail to turn over to the county treasurer money so collected, within fifteen days, he shall be guilty of a misdemeanor: *Provided* that no person liable to road duty under this section shall be required to work on the public roads outside of the township and road district in which he resides, the boundaries of the road districts within each township to be fixed by the county commissioners.

Labor or money paid in lieu thereof to be used in separate townships.

SEC. 5. That any person who shall, after being duly notified as provided in section 4 of this act, fail to appear and work as required to do, (after having failed to pay the sum of two dollars) or any person who shall appear as notified, and fail or refuse to perform good and reasonable labor as required by the said superintendent or supervisor, shall be guilty of a misdemeanor, and upon conviction shall be fined not less than two nor more than five dollars, or sentenced to work on the public roads of the county for not less than ten nor more than twenty days.

Tools and implements.

SEC. 6. That proper implements and tools for use in working the public roads of the county, as provided in section four of this act, may be supplied by the county road superintendent, and shall be paid for out of the road fund of the townships in which the said implements or tools are to be used: *Provided*, that until the county road superintendent shall be able to supply the necessary implements and tools, he may, and is hereby empowered to compel any and all persons working on the public roads of the county to provide themselves with such implements as are commonly used, while working on said road, as the superintendent or supervisor may designate in his notice or summons as being necessary.

Preparation of a list of persons liable for road duty.

SEC. 7. That on the first day of June, 1899, and on the first day of April of each succeeding year, or oftener if required to do so by said superintendent of roads, the township supervisor of roads in each township of the county shall furnish through the county road superintendent to the treasurer of the county a complete list of the names of all persons liable for road duty in the township in which he resides. Said treasurer of the county, after receiving the above list of persons liable for road duty, shall check off the names of such persons as have paid the sum of two dollars as provided in section 4 of this act, and shall, within fifteen days, and as often thereafter as may be necessary, furnish to the county road superintendent a correct revised list of all persons liable for road duty in each said township for the year. A list of such persons liable to road duty in each township, who have during the year failed to work on the public road, after having been duly notified, or to pay as provided for in section 4 of this act, shall immediately be submitted by the county road superintendent or township supervisor to a justice of the peace in the township in which such persons reside, and it shall be the duty of said justice of the peace to immediately issue his warrant for such persons and proceed against them according to law: *Provided, however*, that the defaulting party may be prosecuted at any time and by any citizen of the county.

Penalty for failure to work.

SEC. 8. That all prisoners confined in the county jail, under a final sentence of the court for crime, or imprisonment for non-payment of costs or fines, or under final judgment in cases of bastardy, or under the vagrant acts, all insolvents who shall be imprisoned by any court in said county for non payment of costs, and all persons sentenced in said county to the state prison for a term of less than ten years, shall be worked on the public roads of the county: *Provided*, that [in case the number of such prisoners in any county, at any time, be less than five] the commissioners of the county may arrange with the commissioners of any neighboring county or counties for such an exchange of prisoners, during alternate months or years, as will enable each such cooperating county to thereby increase the number of prisoners at work on its public roads at any given time. And upon application of the said road superintendent of the county, or that of the chairman of the board of county commissioners, the judge of the superior court, or the judge of the criminal court, the justices of the peace and the principal officer of any municipal or any other inferior court, it shall be the duty of the said judge or justice of the peace, or said principal officer, to assign such persons convicted in his court to said road superintendent, for work on the public roads of said county; all such convicts to be fed, clothed, and otherwise cared for, at the expense of the county: *Provided, further*, that in case of serious physical disability, certified to by the county physician, persons convicted in said superior, criminal or inferior courts in the county may be sentenced to the penitentiary or to the county jail.

To work convicts on the rounty roads.

SEC. 9. That when the commissioners of any county shall have made provisions for the expense of supporting and guarding, while at work on the public roads, a larger number of prisoners than can be supplied from that county, upon the application of the commissioners of said county to the judges of the superior and criminal courts presiding in adjoining counties, or any other county or counties in the same or adjoining judicial districts, which do not otherwise provide for the working of their own convicts on their own public roads, may sentence such able-bodied male prisoners as are described in section 8 of this act from such adjoining counties or other counties in the same and adjoining judicial districts to work on the public roads of said county or counties applying for the same, in the order of their application; and the cost of transporting, guarding and maintaining such prisoners as may be sent to any such county applying for the same, shall be paid by the county applying for and receiving them out of the road fund of each such county: *Provided*,

Obtaining convicts from other counties.

that any and all such prisoners from such other counties may at any time be returned to the keeper of the common jail of such counties, at the expense of the county having received and used them.

Regulating the grade and width of more important roads or highways.

SEC. 10. That the principal public roads or highways to be improved or constructed in accordance with the provisions of section 1 of this act, prior to the inauguration of any such permanent improvements on the road or highway to be so improved or constructed, may be first carefully surveyed and located by an engineer or surveyor, trained and experienced in such work, aided by the county road superintendent and such assistants as it may be necessary for him to employ, the same to be paid out of the road fund of the county, for services and expenses as may be agreed upon by the county commissioners. All such public roads or highways where changed or hereafter located or relocated, shall be given a grade nowhere greater than three feet in one hundred feet, in counties situated in eastern North Carolina; five feet in one hundred feet, for counties situated in middle or Piedmont North Carolina; and six feet in one hundred feet in counties situated in the mountain region of the State, and a width of not less than twenty feet, clear of ditches, trees, logs, and other obstructions. All such roads shall be thoroughly drained, and wherever it may be necessary to turn water across the road this shall be done by putting in sewer pipe or other forms of covered drains or culverts: *Provided*, that where, in the opinion of an experienced and competent engineer, insurmountable obstructions make the grades just described impracticable, the grades may be increased to the extent of one foot in one hundred in either of the regions named in this section, for distances of less than fifty feet in one place: *Provided*, *further* that where the roadway must be located on the steep slope of a mountain, its width shall not be less than sixteen feet between ditches, or where blasted out in hard rock the width of such roadway shall be not less than thirteen feet.

Obtaining timber, stone, gravel, etc., from adjacent unimproved lands.

SEC. 11. That for the purpose of carrying out the provisions of this act, the said superintendent and supervisors are hereby authorized to enter upon any uncultivated lands, near to or adjoining such roads, to cut and carry away timber, except trees or groves on improved lands planted or left for ornament or shade, to dig, or cause to be dug and carried away any gravel, sand, clay or stone which may be necessary to construct, improve or repair said road, and to enter on any lands adjoining or lying near the road in order to make such drains or ditches through the same as he may deem necessary for the betterment of the road, doing as little injury to said lands and the timber or improvements thereon as the nature of the case and the public good will permit, and the drains and the ditches so made shall be conducted to the nearest ditch, watercourse or waste ground, and shall be kept open by the said superintendent or supervisors, and shall not be obstructed by the owner or occupant of such lands or any other person or persons, under the penalty of forfeiting a sum of not less than five dollars nor exceeding ten dollars, or imprisonment or work on the public roads of the county for not less than ten nor exceeding twenty days for each and every offence, said penalty to be collected by the said superintendent or supervisors, if in money and paid over to the county treasurer and applied to the road fund of the county.

If the owner of any lands, or the agent or agents of such owner, having in charge lands from which timber, stone, gravel, sand or clay were taken as aforesaid, shall present an account of the same, through the county road superintendent, at any regular meeting of the county commissioners within thirty days after the taking and carrying away of such timber, stone, gravel, sand or clay, it shall be the duty of said commissioners to pay for the same a fair price ; and before deciding upon this they may cause to be appointed an impartial jury of three freeholders, one to be selected by the county road superintendent, one by the party claiming damages, and the third to be selected by these two, which jury shall report in writing to the board of commissioners their decision for revision or confirmation : *Provided*, that said land owner or his agent shall have the right of appeal as provided for in section 13 of this act.

Changing location of roads so as to avoid hills, etc.

SEC. 12. That, subject to the approval of the board of county commissioners, the county superintendent of roads is hereby given discretionary power, with the aid of a competent engineer, or surveyor to locate, relocate or change any part of any public road where, in his judgment, such location, relocation or change will prove advantageous to public travel. That when any person or persons on whose lands the new road or part of the road is to be located claims damages, therefor, and within thirty days petitions the board of county commissioners for a jury to assess the damages, the said commissioners, within not less than fifteen nor more than sixty days after the completion of said road, shall order said jury of three disinterested freeholders to be summoned by the sheriff or constable, as provided by law, who shall give said land owners or their local representative forty-eight hours notice of the time and place, when and where said jury will meet to assess damages; and said jury, being duly sworn, in considering the question of damages, shall also take into consideration the benefits to public travel and to the owner of the land, and if said benefits be considered equal to or greater than the damages sustained the jury shall so declare; and it shall report in writing its finding to the board of county commissioners for confirmation or revision: *Provided*, that if said land owner be a non-resident of the county and have no local representative, it shall be deemed sufficient service of such notice for said sheriff or constable to forward by United States mail a written notice of the purpose, time and place of such meeting of said jury, to the last known post-office address of such land owner, seven days in advance of such meeting; and also to post a notice of the same for seven days at the court-house door of said county.

Right of appeal.

SEC. 13. That in case the land owner or his local representative shall be dissatisfied with the finding of the juries provided for in sections 11 and 12 of this act, and with the decision of the county commissioners, such dissatisfied party may appeal from the decision of the county commissioners to the superior court of the county; all such appeals being governed by the law regulating appeals from the courts of justices of the peace; and the same shall be heard *de novo;* but the judge may, in his discretion, require said land owner to give bond when the case is taken by appeal to the superior court.

SEC. 14. That any officer or employee [appointed] by virtue of this act, or to whom duties are assigned in this act, who shall fail to make complete returns within the time prescribed therein, or who shall otherwise fail to discharge the duties imposed upon him by this act shall in all cases, whether penalties for such failure are or are not prescribed in this act, be guilty of a misdemeanor.

County treasurer, also treasurer of the several township road funds.

Payments of accounts for road work.

SEC. 15. That the county treasurer shall be, and he is hereby appointed, treasurer of the road fund of the county and of the several townships in the same, and for the faithful keeping and disbursing of said money, the bond of such treasurer shall be liable, and for his services in receiving and disbursing such funds he shall receive such a commission as the board of county commissioners may agree upon, not to exceed two per cent, on all moneys disbursed hereunder. He shall pay the accounts against the road fund of the county and of the several townships when itemized statements of the same have been certified to by the county road superintendent and approved by the board of county commissioners.

SEC. 16. The county treasurer shall keep a separate account of the road fund of the county and of each of the several townships therein, and of his disbursements of the same, and he shall make a written report thereof to the board of county commissioners, at their regular meetings on the first Monday in each month ; and on the first Monday in July and January of each and every year, he shall present to the said board of commissioners a written report, giving a statement of the disbursements from the several road funds during the preceding six months, which reports, or the substance thereof shall be published by said commissioners in at least one newspaper published at the county-seat, for at least one insertion.

Inventory and settlement.

SEC. 17. All road funds or securities in the hands of any officer of any county coming under the provisions of this act, or of any township thereof, on the first Monday of June, 1899, shall be promptly turned over to the treasurer of the county, and by him credited to the road funds of the county or of the township to which it belongs; and all teams, machinery, implements, or other equipments belonging to said county or any one of the several townships in the same, held by or under the control of any officers or persons in said county or its townships shall be by said officers or persons turned over to the county commissioners of such county on the first Monday in June, 1899, and by them be held and used on the public roads of the county or of the township owning the same: *Provided*, that the board of commissioners in any county may order such road funds, securities, teams, implements or other road equipment, accounted for and turned over as required above, at any date prior to its regular meeting in June; and officers or persons refusing or neglecting so to do, after having been served with ten days' written notice, shall be guilty of a misdemeanor.

Gradual reduction in number of days for road labor.

SEC. 18. The board of commissioners in any county coming under the provisions of this act, in which the tax for road purposes in the county or any township thereof at the time is not less than 10 cents on the $100 worth of property, may, at its discretion, at its regular meeting in Januory, 1900, or at any regular January meeting thereafter, reduce the number of days of labor required for road purposes in any such county or township thereof in section 4 of this act, such reduction not to exceed one day during any year, reducing also in each case the money to be paid in lieu of such labor at the rate of 50 cents for each day: *Provided*, that for each such reduction in the labor requirement the said board of commissioners shall, at its regular meeting in June next following each such reduction, increase the tax levy for road purposes provided for in section 1 of this act by the amount of 2⅓ cents on each $100 worth of property and 7 cents on the poll.

Reduction of money in lieu of four days' labor to one dollar.

SEC. 19. The board of commissioners in any county coming under the provisions of this act in which the moneys expended for road improvement in the county or any township thereof exceeds an amount equivalent to the tax levy of 12 cents on the $100 worth of property and 36 on the poll, may, at the discretion of said board, reduce the money requirement in lieu of the four days' labor on the roads provided for in section 4 of this act in such county or township thereof to one dollar for each year.

SEC. 20. In any county coming under the provisions of this act which appropriates annually for road purposes moneys derived from the sale of bonds, or from other taxes, not less in amount than the income from a tax levy of 10 cents on the $100 worth of property in such county, the commissioners in said county shall not, while continuing such appropriation, be required to levy the special road tax provided for in section 1 of this act.

Additional township road tax.

SEC. 21. When in any township in any county coming under the provisions of this Act, a petition is presented to the board of county commissioners, signed by a majority of the land owners of said township, asking that in that township an additional special tax be levied for road purposes, or when in any such township, an election being held in accordance with the laws of this state, and the majority of the votes cast at said election being in favor of such special tax, the county commissioners in such county shall, at their next regular June meeting, levy in such township such additional special road tax as they have been requested to levy by said petition or vote, said tax to be levied and collected as provided for other road taxes in section one of this act; and such taxes shall be added to the township road fund of the township in which it is paid and shall be used only on the roads in that township, under the direction of the board of county commissioners, or under the direction of the three township road commissioners named in said petition or vote, if such be named.

Applies to certain counties.

SEC. 22. This act shall apply to the counties of Mecklenburg (excepting sections 4, 5, 6 and 7), Forsyth (excepting sections 4, 5, 6 and 7), Alamance, Rockingham, Gaston, Orange (for Chapel Hill township only), Durham, New Hanover, Pender, Warren: *Provided*, that as applied to the counties of Durham, Mecklenburg, Forsyth, Alamance, Rockingham and Orange (for chapel Hill township), Warren, the word "may" where it first occurs in section 10 of this act be stricken out and the word "shall" inserted in lieu thereof.

May be adopted for other counties.

SEC. 23. In the counties named below in this section, this act may become the road law in each such county, or any township thereof, when adopted as such by the board of county commissioners at any regular meeting, after being requested to do so by petition signed by three hundred (300) freeholders of the county or fifty (50) freeholders of the township; and when so adopted for any such county or township, it shall be the road law for such county or township, and all other laws in conflict with this act, as applied to such county or township shall be then and thereby repealed or suspended during such time as this law may remain in force: Alexander, Granville, Nash, Beaufort, Greene, Northampton, Bertie, Brunswick, Bladen, Caldwell, Catawba, Chatham, Cleveland, Currituck, Edgecombe, Franklin, Halifax, Hyde, Johnston, Jones, Lenoir, Lincoln, McDowell, Moore, Orange (excepting Chapel Hill township), Pamlico, Pasquotank, Perquimans, Rowan, Richmond, Polk, Stanly, Swain, Vance, Washington, Yadkin, Wilson, Jackson, Tyrrell.

Durham county.

SEC. 24. In this act as applied to Durham county, the services of the road superintendent as provided for in section 2, and of the guards as provided for in section 3 of this act, shall be paid for out of the general county fund; and the moneys raised under section 1 of this act in each township shall be expended in the townships paying the same: *Provided*, that the road tax paid in the county by the building and loan associations, railroad, express, telegraph and telephone companies, and like corporations, shall be used for permanent road improvement in the county in such manner as the board of county commissioners may in its judgment deem best, and *Provided further* that in section 4 of this act lines 2 and 3 the clause "except residents of incorporated towns and cities" shall read "except those who reside within the corporate limits of the town of Durham."

Pender county.

SEC. 25. That in this act as applied to Pender county, C. P. More, A. B. Croom and F. P. Flinn of said county shall be and the same are hereby constituted a board of road commissioners for Pender county; vacancies in said board to be filled by the board of county commissioners; members of said road commission to be paid a sum not exceeding $1.50 each per day, while actually engaged in the necessary work of the commission, for not more than three days during any one month; and the said road commission is hereby vested with all the duties, rights and powers (except that of levying taxes) otherwise in this act conferred upon the county commissioners; and the county commissioners shall levy such tax under section 1 of this act as may be recommended by the said road commission, when petitioned to do so by ten responsible freeholders from each of at least six townships in the county.

Chapel Hill township.

SEC. 26. That in this act as applied to Chapel Hill township in Orange county, G. E. Donnell, W. F. Cole and J. A. Holmes of said township, shall be and the same are hereby constituted a special road commission for said township, which road commission, in carrying out the provisions of this act as applied to said township, is hereby vested with all the duties, rights and powers (except that of levying taxes) otherwise in this act conferred upon the county commissioners. The county commissioners under section 1 of this act shall levy such and only such road tax for Chapel Hill township, within the limits prescribed in section 1 of this act, as may be recommended by said board of road commissioners, and all moneys arising therefrom shall be kept separate by the county treasurer and shall be expended in Chapel Hill township; vacancies on said board of road commissioners shall be filled by the board of county commissioners; and its members shall be paid out of the township road fund, not exceeding $1.00 per day each, while actually engaged in the necessary work of the commission, for not more than three days during any one month. Such moneys as may be paid in lieu of the labor in said township may be collected by the supervisor of roads elected by said road commission and deposited by him for road purposes in such manner, and with such person, and expended as may be designed by the said road commission of the township.

Except section one may be adopted by other counties.

SEC. 27. This act shall not apply to the following counties: Anson, Ashe, Alleghany, Burke, Cabarrus, Camden, Chowan, Cherokee, Craven, Carteret, Clay, Columbus, Cumberland, Dare, Davie, Duplin, Caswell, Graham, Gates, Guilford, Henderson, Harnett, Iredell, Macon, Montgomery, Martin, Madison, Mitchell, Onslow, Pitt, Person, Randolph-Robeson, Rutherford, Sampson, Surry, Transylvania, Wayne, Wilkes, Wake, Union, Watauga, Yancey, Scotland, Hertford, Davidson, Stokes, Haywood, Buncombe:

Provided, that in any county or township not coming under the provisions of this act, but otherwise providing funds for road improvement, the commissioners of such county may at any regular meeting, at their discretion, adopt any of the sections (except section one levying a tax) of this act that in their judgment may be specially adapted to the needs of their county and incorporate the same in the road law of the said county.

Does not interfere with existing township system.

SEC. 28. That all laws and parts of laws in conflict with this act are hereby repealed: *Provided*, that nothing in this act shall be understood or construed as in any way interfering with any existing system of township road work in any township already levying a township tax for road purposes, in any county coming under the provisions of this act.

SEC. 29. That this act shall be in force from and after its ratification.

In the General Assembly read three times and ratified this, the 7th day of March, A. D. 1899.

FORM OF PETITION REQUESTING THE ADOPTION OF THE GENERAL ROAD LAW.

The following may serve as a suggestion in the way of the general form of petition to be presented to the county commissioners asking them to adopt this road law as provided for under section 23 of the same:

We the undersigned freeholders of ------------------------county* respectfully petition the honorable Board of Commissioners of this county at their next regular meeting to adopt the general road law entitled, "An act to provide for the better working of the public roads and highways of the State," enacted by the General Assembly of 1899, as the road law for this county. †

---

* Or township of the county of ------------, in case it is desired to adopt the law for some special township and not for the county as a whole.

† Or township, as the case may be.

THE WIDE-TIRE LAW.

ADVANTAGES OF WIDE TIRES.

The benefits resulting from the use of wide tires on wagons and other vehicles are two fold:

1. By the rolling and packing effect of these wide tires the road surface is made smooth and even, instead of being cut into deep ruts, as is the case in the use of narrow tires. Thus a wagon with tires six inches wide will pack twelve inches of road surface every time it passes along; a wagon with tires 1½ inches wide would pack only three inches of road surface; and if we adopt a practice similar to that followed in Europe of having the front and rear axels of different lengths, the wagon with six-inch tires would roll and pack twenty-four inches of road surface. Thus the wide tire not only prevents a road surface from being cut to pieces but it also smooths the surface so as to make it much better for travelling. Even in the case of macadam roads where the surface is more or less hard and firm the narrow tire tends to crush the rock and wear the surface into ruts; whereas the wide tire tends to pack and make smooth this surface.

2. As a rule where the wide tires are used heavier loads can be pulled or the same loads pulled more easily, even taking the road surfaces as they exist, than with narrow tired wagons; and when it is remembered that the wide tire makes a road surface more smooth and even it will be more readily understood that still larger loads can be pulled in any wagon on roads which have thus been packed by wide tires than in the same wagon on another road which has been cut up through the use of narrow tires

The use of these wide tires on all draft vehicles and even on spring vehicles in European countries is almost universal. It has there been a long recognized fact that the use of such tires is not only better for the team but also better for the roads. This practice of using wide tires is now being introduced in many portions of our own country, and on roads of all descriptions—sandy roads, clay roads and macadam roads. The practice is proving beneficial.

The following statement gives some of the more striking results obtained from an elaborate series of experiments comparing the loads that can be hauled on wide and narrow tired wagons, by the Missouri Agricultural Experiment Station:

On Macadam roads an average of 26 per cent. in favor of wide tires.
On gravel roads 26 to 45 per cent. in favor of wide tires.
On ordinary dirt roads 22 to 71 per cent. in favor of wide tires.
On ordinary meadow lands 22 to 84 per cent. in favor of wide tires.
On pasture lands 26 to 89 per cent. in favor of wide tires.
On stubble lands 34 to 72 per cent. in favor of wide tires.
On plowed ground 33 to 44 per cent. in favor of wide tires.
On clay road with deep mud and deep ruts 10 to 49 per cent. in favor of narrow tires. But with the general introduction of wide tires this condition of things (deep mud and deep ruts) would not exist.

The results of these tests, and indeed the whole question of the use of wide tires, is discussed more fully in Bulletin 18 on Road Building in North Carolina, published by the North Carolina Geological Survey, copies of which can be had by application at the Survey office.

THE TEXT OF THE WIDE-TIRE LAW

is given on the following page.

AN ACT TO PROVIDE FOR THE IMPROVEMENT AND PROTECTION OF THE PUBLIC ROADS OF THE STATE, THROUGH THE USE OF WIDE TIRES ON WAGONS AND OTHER DRAFT VEHICLES.

WHEREAS, The use of wide-tired vehicles on the public roads of the State, as shown by experience, will both benefit and protect these roads by packing and smoothing the surface of the same;

The General Assembly of North Carolina do enact:

SECTION 1. That every person, firm or corporation in the State who, during the year ending December thirty-first, 1899, and each succeeding year thereafter owns and uses on the public roads of the State any wagon or other draft vehicles with tires as wide as the standard wide-tire wheels described in section 2 of this act, shall on the presentation of proof thereof, satisfactory to the Commissioners of any county in which said wide-tire vehicles are used, be paid by the county treasurer of such county, out of the road fund of the county or township in which the same is used, each and every year, for a period of five years, a sum equal to one-half his or her road tax: Provided, that in no case shall the amount so paid for any year be greater than two dollars on one such vehicle, nor in any case shall the total amount paid to any one person, firm or corporation exceed the sum of five dollars during any one year; and Provided, further, that in case any such person pays no road tax, he shall during each and every year, for a period of five years, be exempt from one-half of the labor which under the law he may otherwise be required to expend on the public roads of the county or township in which he resides.

SEC. 2. For the purposes of this Act, the standard for wide-tire wagons and other draft vehicles shall be as follows: For a *one-horse vehicle* (with skeins 2½ by 8 inches or under, or spindles 1⅜ by 7 inches or under) two and one-half (2½) inch tires; for *two-horse vehicles* (with skeins larger than 2½ by 8 inches, not over 3 by 9 inches, or with spindles more than 1⅜ by 7 inches, and not over 1¾ by 10 inches) four inch tires; and for all vehicles with skeins and spindles larger than the above, six-inch tires.

SEC. 3. This act shall only apply to the following counties: Alamance, Edgecombe, Lincoln, Mecklenburg, Moore, Orange (for Chapel Hill Township only), New Hanover, Rowan, Wilson, Durham and Granville.

SEC. 4. This act shall be in force from and after its ratification.

Ratified this, the 7th day of March, 1899.

It is advisable to use 6-inch tires even on two-horse wagons.

North Carolina
State Library.

THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 3

TALC AND PYROPHYLLITE DEPOSITS

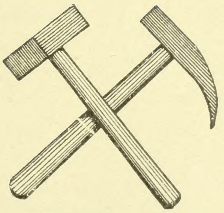
IN

NORTH CAROLINA

BY

JOSEPH HYDE PRATT

MINERALOGIST



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BOARD OF MANAGERS.

Governor D. L. Russell, *ex officio Chairman*	Raleigh.
Charles McNamee	Biltmore.
J. Turner Morehead	Leaksville.

J. A. Holmes, State Geologist	Chapel Hill.

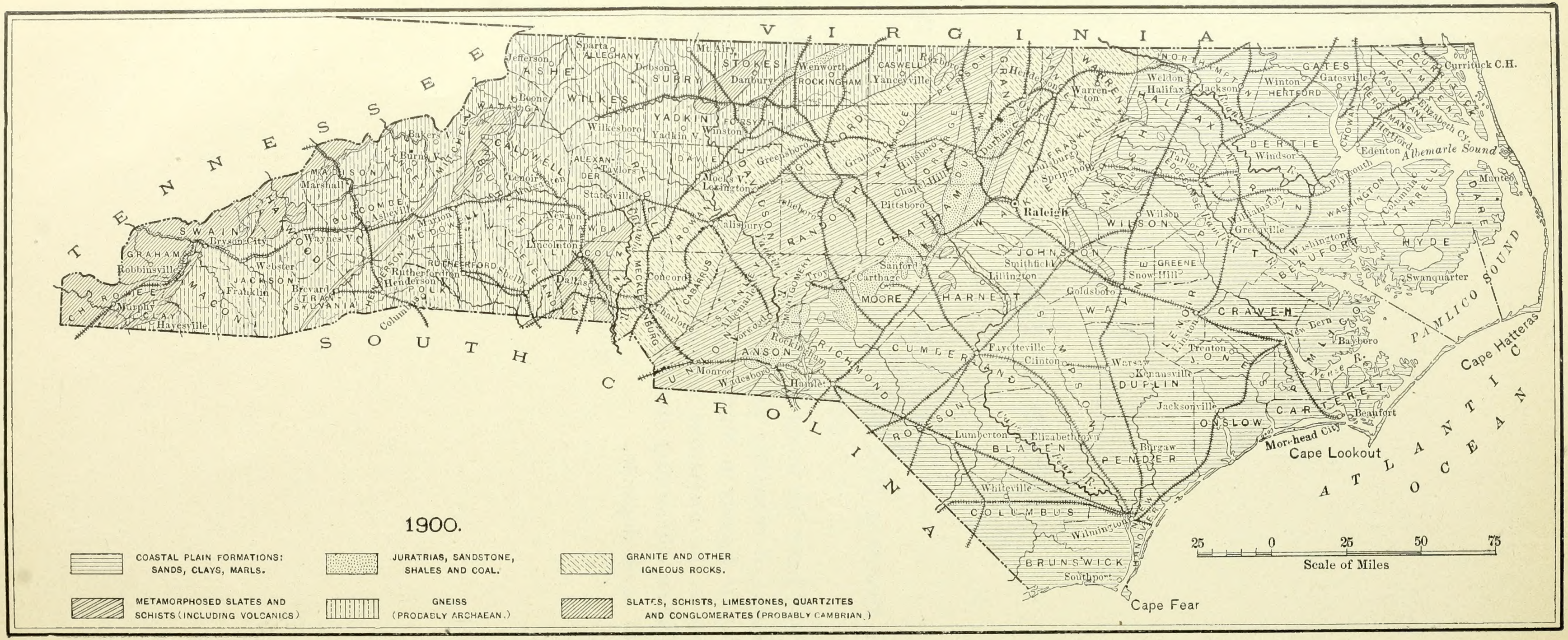
LETTER OF TRANSMITTAL.

Raleigh, N. C., March 1st, 1900.

To His Excellency, Hon. D. L. Russell,
Governor of North Carolina.

Sir:—I have the honor to submit for publication, as the third of a series of economic papers, a special report on the *talc and pyrophyllite deposits* in North Carolina. It has been prepared in response to the numerous applications received at this office for information concerning the nature, extent, location and development of these deposits.

Yours obediently,
J. A. Holmes,
State Geologist.


V I R G I N I A
T E N N E S S E E
S O U T H C A R O L I N A
A T L A N T I C O C E A N
PAMLICO SOUND
Albemarle Sound
Cape Hatteras
Cape Lookout
Cape Fear
Currituck C.H.
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Wilmington
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Charlotte
Greensboro
Fayetteville
New Bern
Morehead City
Beaufort
1900.
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN.)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN.)
25
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Scale of Miles

SKETCH MAP OF NORTH CAROLINA SHOWING THE DISTRIBUTION OF THE PRINCIPAL GEOLOGICAL FORMATIONS.

TALC AND PYROPHYLLITE DEPOSITS IN NORTH CAROLINA.

By Joseph Hyde Pratt.

INTRODUCTION.

The North Carolina talc deposits are at the present time attracting more attention than ever before, for the reason, that known workable deposits of this mineral suitable for making into flour-talc are becoming rare; and that many of the known deposits in the United States that have been supplying the market with talc are becoming exhausted. It is essential then that either a new source of supply or a substitute for this mineral be found.

The properties of talc that make it suitable for the purposes for which it is used, are its extreme softness, being *one* in the scale of hardness, and one of the softest minerals known; its purity, or freedom from grit; its stability; and its smooth slippery touch. The mineral that most closely approximates these properties and is known to occur in quantity is pyrophyllite, and it has been used, to a limited extent, as a substitute for talc. There is no reason, as far as the physical properties are concerned, why pyrophyllite should not be mined as extensively as the known deposits will permit, to be used for the same purposes as talc, with the exception of making into pencils, it not being compact enough for this.

Both the talc and pyrophyllite deposits of North Carolina have been known for over forty years, but their development has only been possible as railroad facilities have come into their vicinity. Now, however, all these deposits are within two and a half miles of shipping points on the railroad, and are being thoroughly prospected.

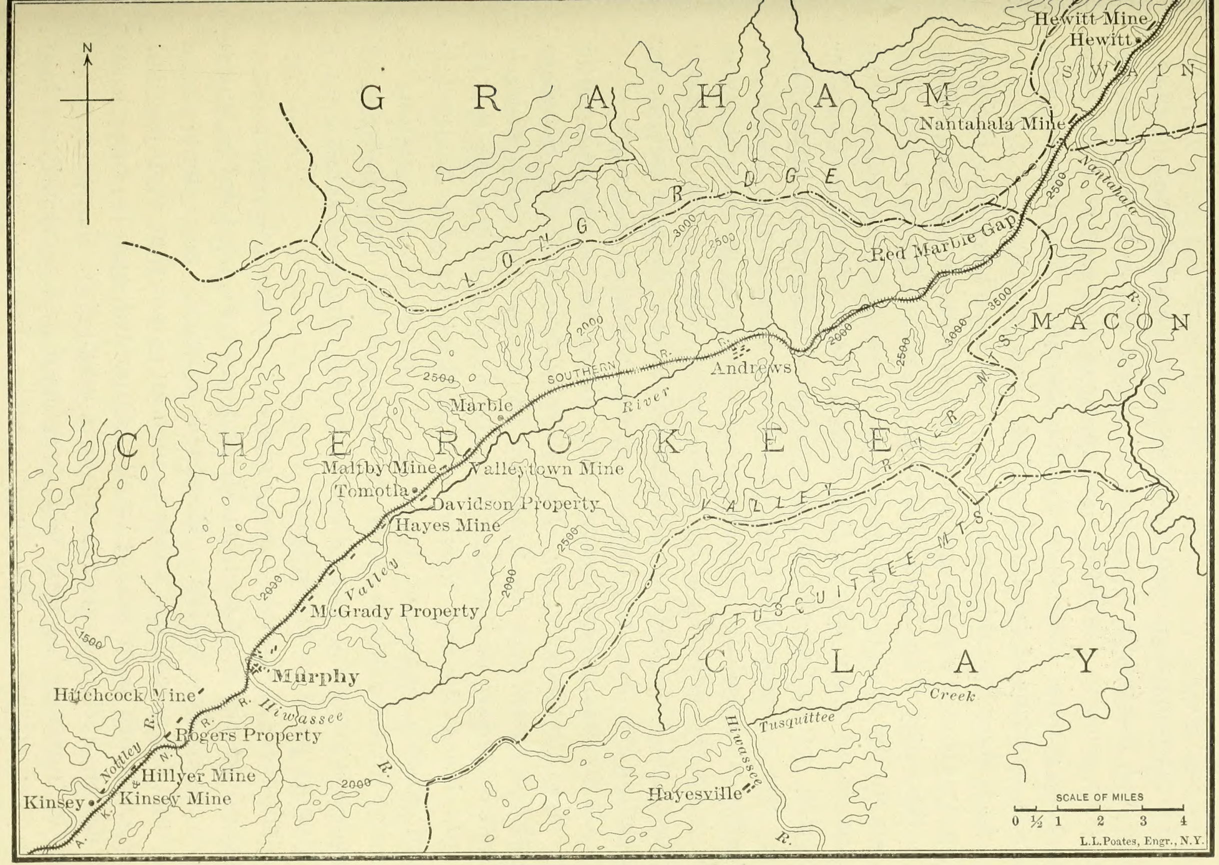
TALC DEPOSITS IN NORTH CAROLINA.

In considering the talc deposits in North Carolina only those are discussed in this paper in which the mineral is suitable for grinding to a powder (flour-talc) or cutting into pencils, and where it occurs in sufficient quantity to permit of its being mined for commercial purposes. While ordinary soapstone is a talc, it is apt to be harder than the foliated variety and to be more or less impure and cannot be used for the above purposes, and for this reason it is not considered in this paper.

Talc suitable for grinding is either foliated talc, which consists of foliæ that are usually easily separated; fibrous, with a more or less silky lustre; or steatite, fine granular to cryptocrystalline; and it must be free from grit. It varies in color from pale green, greenish-white to bluish-white to white. It should not exceed one in hardness.

Talc is a very common mineral, and in small quantity it is widely distributed. It is commonly formed by the alteration of other magnesium minerals, and thus it is an almost constant associate with the peridotite and pyroxenite rocks, with serpentine and with many of the chlorite schists. Beautiful specimens of talc are to be found in nearly all of the peridotite rocks of the State, but no where has this alteration product of the peridotite been found in sufficient quantity to be of any economic importance. Many of the chlorite (talcose) schists contain a large percentage of talc, but the harder minerals associated with it prevents its being of any commercial value. Most of the commercial deposits of talc have been formed from the alteration of other minerals in place. Among the commoner minerals from which it has been derived are tremolite, actinolite and pyroxene.

The only deposits of talc in quantity that are known at the present time in this State are in Swain and Cherokee counties. It was first mined about 1859, when a small amount was being used as linings for the copper furnaces at Ducktown, Tenn. Mr. A. A. Campbell, of Murphy, N. C., was the pioneer of talc mining in this State, and long before the railroads in that section were constructed he was mining and shipping it by wagon to Cleveland, Tenn. With the price of talc at eighty dollars per ton there was a profit even when it had to be hauled this distance. As the price dropped, its mining became unprofitable, until the railroad entered this region; then talc mining was revived.



MAP SHOWING THE DISTRIBUTION OF TALC DEPOSITS (▬) IN PORTIONS OF SWAIN AND CHEROKEE COUNTIES.

The figures 2,000, 2,500, etc., on the contour lines indicate elevations above sea-level.

GEOLOGY AND DISTRIBUTION.

The accompaning map, which has been compiled from the Cherokee and Nantahala topographical sheets of the U. S. Geological Survey, gives in detail the topography of this section of the State and the general location of the talc deposits. The contour lines are at intervals of five hundred feet. (See page 9).

As is shown by this map, the talc formation beginning in Swain county about six miles east of the Valley River mountains, follows up the valley of the Nantahala river to near the Macon county line, then up the Nelson creek ravine and crosses the mountains at an altitude of 2,800 feet at Red Marble Gap. Entering Cherokee county, it then follows down the valley of Valley river, broadening out near Andrews to a width of about one-half a mile; crosses the Valley river and the Hiawasse river and valley in the vicinity of Murphy and follows up the Nottley river valley. The formation crosses the State line into Georgia, but no talc deposits suitable for grinding into flour-talc have as yet been found in that State.

All the deposits are located either along side of the railroad or in close proximity to it. The Murphy branch of the Southern railroad passes over the formation for almost the entire distance from its eastern end to Murphy. To the west of Murphy the Atlanta, Knoxville and Northern railroad follows close to the talc and marble outcrops. Facilities for railway transportation at nearly all the deposits are of the best, and but little hauling by wagon is necessary, two miles being the longest distance from a shipping point on the railroad.

The rocks of the talc-bearing region in these southwestern counties are for the most part marble and quartzite, bordered by gneiss and crystalline schists. Repeated dynamic movements have twisted and folded the strata to such an extent that their original structure has been almost wholly obliterated, and in many cases it has changed considerably their mineralogical character. Part of the limestone has been metamorphosed and recrystallized into compact marbles of the finest quality, while the sandstone has been converted into a quartzite, which at times is almost without perceptible granular structure.

As far as these beds of marble have been examined they are for the most part free from layers of silicates or quartz, except of course those in proximity to its contact with the quartzite. Near the contact, but in the marble, tremolite of a nearly pure white color and in prismatic crystals up to a quarter of an inch in diameter has been found. The limestones which were first laid down and subsequently covered by the sandstone, from which the marble and quartzite are the final results, can be traced from about a mile east of Hewitt, Swain county, in a southwest direction across Swain, Macon and Cherokee counties into Georgia. The width of this marble belt varies from a few hundred yards to over half a mile as along Valley river near Andrews, Cherokee county. The Valley River mountain ridge, the boundary between Macon and Cherokee counties, is an anticlinal fold, with a N. W.–S. E. trend which marks rather sharply in some respects the character of certain formations to the northeast from those to the southwest. To the east of this ridge the marble-quartzite formation is bounded on the south and north by a slate, while to the west of this ridge this formation is bounded on the south by crystalline schists and slates on top of which are numerous beds of limonite iron ore. To the east of the ridge there are apparently no deposits of limonite. The depth of the stratum of marble has not been determined, but it is known to be over 100 feet.

The strata dip at all angles, due to its being repeatedly folded, but has a general trend of about N. 35° E.

It is in connection with this marble formation that the deposits of talc occur. What was formerly supposed to be a regular vein of the talc was probably a series of pockets of this mineral of varying thickness, lying for the most part directly between the marble and the quartzite, although at times they are entirely enclosed by the marble. None, however, have been observed that were enclosed by the quartzite. These pockets, which resemble in shape flattened lenses, always follow the dip of the strata in which they occur, and are therefore encountered in all positions from horizontal to vertical.

These pockets of talc were once much more abundant than they are now observed. At the present time the only evidence as to the former existence of many of these is the occurrence of a bluish clay containing a few scattered flakes of talc. Wherever the quartzite capping of the pocket of talc has remained the talc is in a good state of preservation; but, on the other hand, wherever the quartzite has been removed by disintegration and erosion the talc has been either partially or wholly decomposed into the bluish clay. In places the talc is found wholly surrounded by the marble as at the Kinsey mine, where small pockets or lenses of the talc are in the marble but still close to the contact.

The beds of limonite iron ore are found closely associated with the marble and talc deposits between the Valley River mountains and the Nottley valley. The iron ore which always lies to the south of the talc is sometimes almost in direct contact with it. The yellow stains observed upon so much of the talc in this region is undoubtedly due to its proximity to the iron ore. Although there are a number of iron ore deposits in the Nottley river valley, they are not in close proximity to the talc and marble, and have exerted but little influence upon the character of the talc. It is in this valley that the most beautiful talc has been found.

Folding and subsequent erosion of the strata have brought the marble and talc to the surface at a number of points along these valleys of the Nottley and Valley rivers, and on the slopes of some of the adjacent ridges. In the broader portions of the valleys they are often covered by an alluvial soil which in places reaches a depth of from twenty to thirty feet.

ORIGIN OF THE TALC.

As is well known, there are many minerals which under favorable conditions yield talc as an alteration product; of these the most common being pyroxenes, amphiboles and certain of the micas. Tremolite is one of the amphiboles that commonly yields talc as an alteration product, and in connection with these talc deposits of Cherokee and Swain counties, it is the author's opinion that they are the result of the alteration of former deposits of tremolite.

There are a number of reasons which have led to these conclusions. In many of the marbles along the contact of the talc there are small branches of radiating crystals of tremolite, while in others there are similar crystals which are entirely altered to talc. Also at a number of places, as at the Maltby mine and on the property of the Cherokee Iron, Marble and Talc Co., talc has been found at the contact of the marble which had branching through it many crystals of tremolite. In examining the structure of the talc it is found to be decidedly fibrous, although this is not always apparent in the large masses. When these masses are crushed and examined with the magnifying glass in many cases they are seen to be made up of small fibers. Even the compact talc is observed to have more or less of a fibrous structure when crushed and examined with the higher power microscope. But very little of what could be called a foliated talc has been seen. Tremolite is the only mineral that I have found associated with the talc, except of course the calcite of the marble and the quartz of the quartzite. Except where tremolite has been observed in the talc, the latter is generally free from grit.

CHARACTER OF THE TALC.

There is a decided difference in the character of the talc to the east of the Red Marble gap region from that to the west. It is more compact and of a bluish-white to white color, and a considerable portion of it is suitable for cutting into pencils; while that to the west, of a pale greenish to white to bluish-white color, is more fibrous to foliated, although this characteristic is sometimes not very distinct in the mass, and but little of it is suitable for cutting into pencils. The fibrous structure, which at times is almost a bladed prismatic one, is sometimes very marked, especially in the talc that is found penetrating into the marble. When the talc is crushed and examined under the microscope or magnifying glass the fibrous structure is very pronounced.

Some of the talc found at the Kinsey and Hillyer mines, four and five miles southwest of Murphy, is translucent to transparent and is the finest quality that I have ever seen. All the talc, except when stained with iron and of the dark bluish colors, grinds to a white flour, which is free from grit.

A considerable quantity of the talc is unfit for grinding to a flour on account of its being very badly discolored by iron oxide, or having a great many tremolite crystals penetrating through it in all directions. This is observed more generally in the talc that is found in the valley of Valley river.

The following analyses* have been made of the talc from the Kinsey mine (No. 1), representing the extreme western end of the formation; from the Hewitt mine (No. 2), representing the eastern end, and from the Maltby mine (No. 3), near the middle of the formation:

ANALYSES OF TALC:

	Kinsey Mine. (1)	Hewitt Mine. (2)	Maltby Mine. (3)	Theoretical Composition of Talc.
Water (loss on ignition), H_2O	4.36	5.10	6.14	4.76
Silica, SiO_2	63.07	61.35	56.80	63.49
Alumina, Al_2O_3	1.56	4.42	9.06	
Ferrous Oxide, FeO	0.67	1.68	1.84	
Lime, CaO	0.30	0.82	1.40	
Magnesia, MgO	28.76	26.03	23.98	31.75
Soda, Na_2O	0.79	0.62	0.72	
Potash, K_2O	Trace	Trace	Trace	
Total	99.51	100.07	99.95	100.00

In the above analyses the samples taken were of the best quality from each locality and, as is shown by analysis (1), that from the Kinsey mine approaches closely to a chemically pure talc.

Thus far no use has been made of the talc that is unsuitable for grinding to a flour, which in some cases amounts to a considerable per cent. of the output of the mine, and it would be of great advantage if this waste material could be utilized. There are good reasons for believing that this can be used in the manufacture of a fire-brick, and if experiments that are now being made show this to be practicable, this waste talc could be used where produced, for there are beds of good clay in the immediate vicinity.

---

*By Dr. Charles Baskerville, University of North Carolina.

MINING AND CLEANING.

The mining of the talc does not present any serious problems, as the deposits do not extend to any great depth. Those in the low lands of the valley have to contend against water, which occasionally causes considerable loss of time. Most of the mines thus located have been worked by means of open pits, which during a period of rain have to be abandoned owing to flooding. While some of these deposits, especially those on the hillsides, can be worked to advantage by an open pit, the majority of them can best be worked by shafts and tunnels, leaving one shaft as a pumping shaft and draining all the water from the others and the tunnels to this one. By using a series of tunnels one above the other the mine is kept as dry as it is practically possible.

At the Hewitt and Kinsey mines, from the nature of their location, the work has been successfully done by open cuts and tunnels. But little blasting is necessary at any of the mines, as the width of the deposit is usually sufficient for open cuts or tunnels without interfering to any great extent with the harder wall rocks.

As the rough blocks of talc are taken from the mine they are hand-cobbed, if necessary, and sorted into three grades. The larger pieces are cleaned by rubbing them with steel brushes, and the smaller ones by an ordinary founder's scouring machine. They are then dried by being spread over a floor of steam-pipes which are kept at a temperature of about 212° F. When dry, the pieces are crushed and ground and the foreign material removed by seiving. It is then further ground and the product passed through bolting-cloth, making the final product of nearly uniform grain. In grinding or pulverizing the talc a buhr-stone mill is used, the same as in grinding wheat. The ground product is handled very much like flour, and in filling the bags with the flour talc an ordinary flour packer is used.

TALC PROPERTIES BEING DEVELOPED.

North Carolina Talc and Mining Company.—The most important work done east of Red Marble gap is at Hewitt station, by the North Carolina Talc and Mining Company, of which Frank A. Hewitt is manager. The talc deposits here are on the south face of a hill rising almost directly from the Nantahala river. The pocket of talc is resting on a bed of marble, with hanging wall of the same rock and is capped by quartzite. This pocket or bed is almost continuous for nearly 1,500 feet, and includes the adjoining property of the Nantahala Talc and Marble Company. The deposit has been worked for about 500 feet in length by the North Carolina company, and they have cut into the bed of talc to a depth of nearly 40 feet. Other pockets of talc have been opened and extensively mined to the west of this main pocket, but in the same range of hills.

To determine whether there was any considerable depth to the deposit a drill was run into the hill for 95 feet, starting at about 15 feet above the railroad track, which is between the hill and the river. The drill penetrated through marble for the whole distance, which carried it beyond the north wall of the talc, showing that the deposit of the talc had pinched out at that depth. As the bed was worked toward the northeast it widened to 14 feet, making the average width of the deposit about 11 feet. The marble in contact with the talc is dolomitic in character but contains a great deal (42.70 per cent.) of free quartz and tremolite.

A large percentage of the talc mined is of No. 1 quality, only about one-fourth of it being off color, of which a portion is of a rather dark bluish tint. More material suitable for cutting into pencils is obtained from this mine than any of the others.

During the past year (1899) over 900 tons of talc were mined and shipped, of which all but 43 tons were made into flour-talc. Of this about 700 tons was of No. 1 quality. The 43 tons referred to were cut into pencils of various sizes.

There is but very little hauling of the crude talc necessary, as the mill is located at the foot of the hill on the narrow strip of ground between the railroad track and the river. This location also makes it very convenient for shipping the commercial products. The mill has a capacity of 10 tons of flour-talc per day.

NANTAHALA TALC AND MARBLE COMPANY.—Adjoining the property of the North Carolina Talc and Mining Company on the west is that of the Nantahala company. This company also owns the land adjoining the North Carolina company on the east. The occurrence here is very similar to that at Hewitts, being on the same range of hills rising from the Nantahala river and the property taking in part of the same vein. The talc is of very good quality and considerable of it is compact enough to be cut into pencils. Only a little work has been done here during the past year.

But little mining has been done for talc between these properties just described, on the east, and near Tomotla, on Valley river, Cherokee county, on the west, an intervening distance of about 20 miles. This does not mean, however, that there are no talc beds throughout this distance, but only that the favorable portions for the occurrence of talc in this section of the formation have not been as thoroughly prospected as others. It may be found, as this region is more carefully prospected, that talc beds which may have originally been here have been subsequently altered and removed by erosion.

VALLEYTOWN MINERAL COMPANY.—This company has done a little mining about two miles northeast of Tomotla, or six miles northeast of Murphy, in Cherokee county. About 200 tons of talc were obtained, some of which was badly mixed with tremolite, from a pit close to the railroad. A mill was erected for grinding the talc but it has been closed for nearly a year and no mining has been carried on during that time. From the indications observed here, there is reason to believe that there is a considerable bed of talc on this property.

SOUTHERN MINERAL COMPANY.—Less than a mile to the southwest of the above property is the old Maltby mine, now owned by the Southern Mineral Company, of which D. C. Curtis, of Tomotla, is manager. The work done at this mine consists of a pit approximately 70 feet square, and 10–20 feet deep, cutting across the bed of talc. Near the centre of the pit a shaft 15 feet deep has been sunk, which penetrated the talc and entered a greenish talcose rock which was very gritty. A few feet to the south of the pit two additional shafts have been cut to a depth of 30 feet, the lower ten feet of which penetrated talc. But little work has been done to accurately determine the depth of the talc, but borings have been made at angles of 45°, which penetrated talc for more than 50 feet. The southeast or hanging-wall is a marble and the northwest or foot-wall is a quartzite. The dip of the strata is 5°–10° S. E. A little prospecting has been done in the vicinity of the mine which has showed the presence of pockets of talc which contain a great deal of tremolite. In excavating for the foundation of the mill, talc was uncovered. The marble in contact with the talc is dolomitic in character and carries occasionally crystals of tremolite. As there is no chance to run a cut into the pit all the talc and waste material are hoisted by whim and derrick. It is probable that this mine could be worked more profitably by shafts and tunnels.

Considerable of the talc from this mine is off color and according to the discoloration is classed as No. 2 or No. 3. These lower grades are, however, usually as free from grit as the No. 1 talc. None of the material thus far obtained from this mine is compact enough for cutting into pencils. Mr. Curtis reports that about 1,000 tons of the various grades have been mined, of which a portion was ground, and part shipped in the rough masses as mined. The mill on this property is one of the best equipped of any in the talc region, and has a capacity of 15 tons of flour talc per day.

Davidson Property.—One mile southwest of the Maltby mine, and at Tomotla, the formation crosses the farm of Winslow Davidson. A few pits have been sunk in the lowlands of Valley river to the southeast of the railroad track and opposite the depot. In a number of these pits talc of good quality was encountered, but no work has been done to demonstrate whether or not it exists in quantity.

Hayes Mine.—This mine is about five miles northeast of Murphy and one mile southwest of Tomotla on the property of J. F. Hayes. On this talc deposit there is an open cut about 60 feet long, 40 feet wide, and 30 feet deep, following down its contact with the marble on the southeast. Tests made by boring show that there is a considerable width and depth of talc at this mine, and test pits made, 50 feet to the southwest and 200 feet to the northeast, indicating that along the strike the pocket extends for some distance.

According to Mr. Hayes, about 1,000 tons have been taken out of this mine in recent years, of which only about twenty-five per cent. was of first grade. The talc was not so badly stained at the lower depth and was freer from grit. No mining has been done during the past year.

Between the Hayes mine and the next property of importance on the west, that of the Cherokee Iron, Marble and Talc Company, there has been but little prospecting, and nothing of importance has been found.

CHEROKEE IRON, MARBLE AND TALC COMPANY.—This company's property, of which Edward McCrady, of Charleston, S. C., is president, extends to within about a mile of Murphy, following along the talc-bearing formation for over two miles. Prospecting was undertaken by means of shafts and pits, and in the latter part of November (1899) by boring with an auger. While this work has shown the presence of a considerable quantity of talc it has not yet shown much of good quality. Mr. A. S. Emerson, of Baltimore, Md., who is mining for talc at the Kinsey mine, has been testing the property by boring holes through the soft material until the solid rock was encountered. Most of the talc found thus far has been mixed with a considerable per cent. of tremolite, and much of it has been badly stained. As prospecting is continued, it is not at all unlikely, but is very probable, that good deposits of talc will be found, free from stains and grit.

HITCHCOCK PROPERTY.—This property, comprising about 2,700 acres, is the first one to the west of Murphy where there has been any prospecting for talc. A number of cuts and small pits have been made at various places which have shown the presence of talc, but for the most part of inferior quality. Systematic boring would be the easiest and quickest way to determine whether there are any deposits of good talc. From the indications shown by the present prospecting, it is not unreasonable to expect that good de-

North Carolina
State Library.

posits will be found on this property. The nearest shipping point on the railroad is Murphy, a distance of two miles. This property is now owned by Mrs. Lily Coit, of San Francisco, Cal.

ROGERS PROPERTY.—This adjoins the Hitchcock property on the southwest, and has been prospected to a limited extent, both by pits and borings. No definite information could be had regarding this, but it is reported that good talc was encountered in many of the borings. The property extends for two miles along the marble-talc formation, but more thorough prospecting is necessary before anything definite will be known regarding either the deposits of talc or of marble. The Atlanta, Knoxville and Northern railroad crosses the property.

HILLYER PROPERTY.—This property, including the Hillyer mine, lies to the southwest of the Rogers Tract along the Atlanta, Knoxville and Northern railroad, about four miles southwest of Murphy, and is owned by the Atlanta Talc, Mining and Manufacturing Company, of which Judge George Hillyer, of Atlanta, Ga., is the president.

Mining has been carried on quite extensively at this mine, which is one of the largest and best that is known on the talc formation. Three shafts nearly in a line, with the strike of the rocks and 100 feet apart have been sunk on the bed of talc penetrating this for 27 feet, making a total depth of each shaft about 60 feet. The foot-wall of quartzite is but 16 feet from the shafts, and is dipping nearly 30° to the southeast. The width of the bed is known to be 40 feet, but no tests have been made to determine its actual width or depth. A little to the northwest of the line of shafts and 300 feet to the southeast, a tunnel 100 feet long was run along the quartzite contact and good talc encountered.

This mine has yielded several thousand tons of the finest quality of talc, but practically none of it was compact enough to be used in cutting into pencils. The mine when examined was full of water, so that nothing could be seen of the talc in place, and nothing definite can be said regarding the quantity, but judging from what has been obtained from the mine, and the report of the amount of work done, and from what could be gathered from surface indications, there is a large quantity of good talc still in this mine.

Notla Marble and Talc Company.—This company's property is located at and in the vicinity of Kinsey, N. C. The talc deposit is known as the Kinsey Mine, and is being worked by A. S. Emerson, of Baltimore. The larger part of the talc from this mine has been found wholly within the marble, but near the contact of the marble with the quartzite. Two tunnels, one of them having a length of 75 feet, have been run in on the deposit, one ten feet below the other. The talc occurs in a series of rather flat lenses which yield a product of the finest quality, like that obtained from the Hillyer mine. That found at the contact between the marble and the quartzite is not of as good quality as the talc entirely surrounded by the marble. These pockets of talc at the Kinsey mine have been pretty thoroughly worked out, and other portions of the company's lands are now being prospected by borings to locate if possible other deposits. Blocks of talc have been obtained from this mine that have weighed nearly a thousand pounds. A mill connected with this property has a capacity of six tons of flour-talc per day. The railroad passes by the mine and within a very short distance of the mill.

There has been but very little talc found to the southwest of the Kinsey mine, and nothing has been observed that has indicated the existence in that direction of any important deposits of this mineral.

MARBLE ASSOCIATED WITH THE TALC.

Associated with all the talc deposits described above is marble, which in many localities is in such quantity and of such quality as to be of commercial value. The marble varies in color from white to pinkish and bluish. While a great deal of the marble has been too much broken in connection with the folding and general up-lift of the rocks of the region to be available as a building stone, there are however, a number of deposits in which it is of considerable economic importance.

At the present time the only locality that is being worked is at the Kinsey mine, some four miles southwest of Murphy. The marble here is of a pinkish-white and bluish-gray color, and of a uniform texture.

Some of the most promising outcrops of marble are in the valley of Valley river. Of these the one which has shown the most promising prospect is at the Hickerson place, across the river from the railroad depot at Andrews. The deposit here has been tested by means of boring at a number of places, and it was found sufficiently solid and free from cracks to make it suited for building and ornamental purposes. It is white in color, fine grain and compact, and indications seem to show that this can be used as a statuary marble.

Marble outcrops at intervals from the Kinsey to the Hewitt mine, and it is not at all improbable that other deposits of commercial value will be found in connection with this talc belt.

The marble that is in direct contact with the talc deposits is dolomitic in character, as seen by the analyses below. The pink and blue marble found at the Kinsey mine show but a very small per cent. of magnesia. In the following analyses,* Nos. 1, 2 and 3 are of white marble that is in direct contact with the talc at the Kinsey, Maltby and Hewitt mines respectively; No. 4 is of the pink and No. 5 of the blue marble from the Kinsey mine.

ANALYSES OF MARBLE ASSOCIATED WITH TALC DEPOSITS.

	White Marble, Kinsey Mine.	White Marble, Maltby Mine.	White Marble, Hewitt Mine.	Pink Marble, Kinsey Mine.	Blue Marble, Kinsey Mine.
	(1)	(2)	(3)	(4)	(5)
Insoluble residue.........	5.20	2.10	42.70	2.90	2.80
Lime, CaO..................	28.62	30.14	17.62	49.10	52.30
Magnesia, MgO.............	19.27	20.70	11.48	3.67	0.50

In the first three of the above analyses the ratio of the CaO : MgO is as follows:

No. 1, CaO:MgO=.511:487=1.05:1.
No. 2, CaO:MgO=.538:517=1.04:1.
No. 3, CaO:MgO=.314:287=1.09:1.

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* By Dr. Charles Baskerville, University of North Carolina.

These are very close to 1:1, which shows that they represent normal dolomite marbles, and as these analyses are of samples from three points at different places on the formation, they indicate that all the marble in contact with the talc is of the same general character.

The marble from Hewitt's (No. 3) contains a large percentage of impurities which were very apparent in the hand specimen. This, however, graded into a marble that was very free from grit. That from the Maltby mine (No. 2) shows a very pure marble close to the contact, and that from the Kinsey mine (No. 1) does not contain a very large percentage of impurity. The insoluble residue consisted of talc, quartz, and sometimes a little tremolite.

The pink and blue marble from the Kinsey mine (Nos. 4 and 5) are very pure lime marbles, the latter containing but little more than a trace of magnesia.

It is not unreasonable to expect that the near future will see considerable activity in marble quarrying in this section of the State.

PYROPHYLLITE (AGALMATOLITE).

The name agalmatolite properly means a variety of pinite, one of the micas, but it has been loosely used for a variety of minerals, as compact talc (steatite) and compact pyrophyllite. The name was originally used for a soft mineral found in China, which was used for carving into minature images, considerable of which was a genuine pinite, but some of that used was a compact talc and pyrophyllite. Thus the name has been given to talc and pyrophyllite from a number of localities on account of their resemblance to the pinite (agalmatolite) of China.

It is seen from the analyses on page 26, that the so-called agalmatolite from Moore and Chatham counties, North Carolina, is not a pinite but a pyrophyllite. As the name agalmatolite has been so constantly used as a trade name, for the mineral from these counties, it will be given in parentheses after the name pyrophyllite wherever it is necessary to use the name in describing the mineral.

OCCURRENCE OF PYROPHYLLITE IN NORTH CAROLINA.

The pyrophyllite (agalmatolite) deposits are located in the extreme north central portion of Moore and the south central part of Chatham counties, and can be traced across the country for a distance of eight miles. The principal mining that has been done is near the boundary between the two counties in the vicinity of Glendon, Moore county. They are associated with the slates of this region but are not in direct contact with them, being usually separated by bands of silicious and iron breccia, which are probably 100 to 150 feet thick. These bands of breccia contain more or less pyrophyllite, and they merge into a stratum of a pyrophyllite schist. Between this and the massive beds of pure pyrophyllite there are very often small seams of quartz and larger lenticular quartz masses, several feet thick.

The strike of this formation is approximately N. 55°–60° E. and dipping 60°–70° to the northwest. It is first encountered about three and three-fourth miles southwest of C. H. Womble's house, and three and one-fourth miles beyond Deep river. Where the formation crosses the river there is a good outcrop of the pyrophyllite, and then at a point 100 yards to the northeast and extending for about half a mile, the mineral has been mined at intervals. Beyond this point, which is near Rogers creek, there has been no mining, but the formation can be followed for another three miles to the northeast. In this distance there are many promising outcrops of the pyrophyllite, which will probably develope into as good deposits as any that have been heretofore opened.

The beds of this mineral are not entirely of commercial quality, but there are bands of the pyrophyllite that are highly silicious along side of those that are entirely free from grit. Although the general appearance of the waste and good material is very similar, they can readily be distinguished by the touch, and can readily be kept separate by hand cobbing.

Small seams of quartz often penetrate into the beds of pyrophyllite, cutting across the bedding of the formation, while those between this and the brecciated rock or schistose rock are parallel with the strike.

Besides the quartz as an impurity, portions of the deposit are filled with small particles, some of which are chlorite, and others hematite, giving them a decided speckled appearance. These portions vary from seams a few inches in width to lenses several feet thick.

A cross section of these beds will probably not show an average of over twenty-five to thirty per cent. of commercial pyrophyllite.

The pyrophyllite rocks have a width of about 500 feet, but not over 100 feet of this would constitute the workable deposits, and of this but twenty-five per cent. would be of commercial pyrophyllite (agalmatolite). This, however, is so located that not over fifty feet would have to be mined to obtain the twenty-five feet of good number-one material.

While the talc deposits of Cherokee and Swain counties are pockety in nature and of limited depth, the pyrophyllite formation is continuous and of considerable, though of unknown depth.

Since the construction of the railroad from Gulf, Chatham county, to Carthage, Moore county, by the Durham and Charlotte R. R. Company, nearly the whole pyrophyllite formation has been brought into close proximity with railroad facilities, thus making the mining of these deposits a practical proposition.

While possessing many of the physical properties of talc and often being mistaken for it, the pyrophyllite is quite different in its chemical composition, and is a distant mineral species. Although this mineral probably cannot be put to all the uses of talc, it can be used for the larger number of them, and those for which the talc is used in the greatest quantity. Some of this might be of such quality that it could be cut into pencils, but the most of this mineral would only be of value when ground. It is soft with a greasy feel and pearly luster, and has a foliated structure. The color varies from green, greenish and yellowish-white to almost white; but when air-dried they all become nearly white. Very little compact pyrophyllite has been observed that would be suitable for carving, as is used in China, although considerable of this has been used in the manufacture of slate pencils.

Chemically, pyrophyllite is a hydrous aluminum silicate, while talc is a hydrous magnesium silicate. The following analyses* have been made of three samples of this mineral, from the property of the Rogers Creek Mining Company:

ANALYSES OF PYROPHYLLITE (AGALMATOLITE):

PYROPHYLLITE.	Black Variety. (1)	Yellowish-white Variety. (2)	Apple-green Variety. (3)
Water (loss on ignition) H_2O	5.86	5.45	5.85
Silica, SiO_2	61.27	64.53	63.50
Alumina, Al_2O_3	25.66	29.40	28.73
Ferrous Oxide, FeO	5.37	0.67	0.84
Lime, CaO	0.60	Trace	Trace
Magnesia, MgO	Trace	Trace	Trace
Soda, Na_2O	0.83	0.28	0.37
Potash, K_2O	0.11	Trace	Trace
Total	99.70	100.33	99.69

In the above analyses No. 1 represents a black variety of the pyrophyllite, which was apparently free from any grit, and the dark color was undoubtedly due to the large percentage of iron that the mineral contained. The other two analyses are of two samples of the massive mineral of first quality, as it was obtained from the mine, No. 2 being of a yellowish-white and No. 3 of an apple-green color. As is noticed in these analyses the percentage of iron is very low and the composition of the mineral is made up almost entirely of alumina (Al_2O_3), silica (SiO_2), water (H_2O) and only a trace of magnesia.

The ratios of $Al_2O_3 : SiO_2 : H_2O$ are in 1, $= 1.08 : 4 : 1.12$, and in 2, $= 1.08 : 4 : 1.24$, which are approximately $1 : 4 : 1$, giving the formula H_2O, Al_2O_3, 4 SiO_2, the same as for pyrophyllite.

That these pyrophyllite schists and beds of the massive mineral were not steatite, or the genuine agalmatolite was first shown by Prof. George J. Brush,† of Yale University. In 1862 he had specimens of this mineral which was at that time supposed to be talc (soapstone), analyzed in the Sheffield laboratory with the result that they were shown to be identical in composition with pyrophyllite, and that the variation in the pyrognostic properties of the different varieties is entirely due to their structure.

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* By Dr. Charles Baskerville, of the University of North Carolina.

† Am. J. Sci., No. 34, 1862, p. 219.

These deposits have been known for over fifty years but there has been but very little systematic mining, and what material was obtained was used for the same purposes as talc.

The pyrophyllite, after coming from the mine, is cleaned and treated the same as talc, being first dried and then cleaned by brushing, then crushed, seived and passed through bolting-cloth. The ground product is almost identical in appearance with flour-talc, and should bring in the market about the same prices that talc does.

MINING PROPERTIES.

PHILLIPS PROPERTY.—Beginning at the southwest portion of the formation, the first locality at which any mining has been done is on the Phillips property, about one and a half miles northwest of Glendon and a third of a mile northeast from Deep river, and extending from 1,200 to 1,500 feet on the pyrophyllite formation.

This property has been opened up at intervals during the past thirty-five years, the last work being done by the White Soapstone Company of New York City. The deposit has been opened along the strike for a distance of about thirty-five yards by a cut varying from ten to twenty feet in width and ten to twenty feet in depth. Near its southwest end there is an additional cut five feet deep by twenty feet wide. Very little good pyrophyllite is in sight at any of the openings on this property; but the indications are that material of good quality will be found if the property is thoroughly developed. No mining has been carried on here for a number of years.

WOMBLE PROPERTY.—The property adjoining the Phillips to the northeast is the Womble, which extends along the formation for a distance of 1,200 feet. It is now owned by Mrs. Cora C. Fry, of Glendon; but is controlled and operated by C. H. Womble. Small pits have been sunk at intervals for nearly its entire length, but the mining now being done is at the northeast end of the property and consists of an open pit forty feet deep and from ten to twenty feet wide, which follows along the strike. The mineral obtained here is of very fine quality, of a white to yellowish-white color.

Adjoining the Womble property is a narrow strip of 100 feet, owned by H. O. Gard, of Marrietta, Ohio; and next to this another narrow strip of 130 feet, owned by Mrs. Fry. A little work has been done on both of these properties, but nothing of any importance beyond showing that the formation is constant.

The Rogers Creek Mining Company.—The property of this company, which is the next on the northeast, extends for a distance of 785 feet along the formation to and beyond a small creek which flows into Rogers creek. This company has started out in the most systematic manner in mining for the pyrophyllite. A large open cut has been made on the northeast face of the hill which rises gradually to a height of over 100 feet above the branch. The cut is toward the southwest on the strike of the pyrophyllite schists and extends into the hill for a distance of seventy-five feet, with inclination sufficient to drain it at the bottom. At the southeast end, when the mine was visited in November, 1899, the cut was thirty feet deep and about sixty feet wide, broadening from eighteen feet in width at the entrance, this work having been done during 1899. The facilities for mining the mineral cheaply are better at this mine than any of the others now opened.

There has been no mining to the northeast of the small branch crossing this tract, but prospecting pits have shown that there are deposits of this material as promising as those which have already been opened.

The next 700 feet of the formation, northeast of the Rogers Mining Company's property, is owned by Mrs. J. P. Gilliam, Pocket, Moore county. Beyond this to the northeast, and taking in nearly a mile of the formation, is the property of the George H. Snow estate, Raleigh, N. C.

BY-PRODUCT IN PYROPHYLLITE MINING.

In mining the pyrophyllite (agalmatolite) there is a considerable percentage of the mineral that is not suitable for making the ground product, on account of the grit (usually quartz and the small black specks referred to above) that it contains. It is therefore very desirable that some commercial use be found for this waste material. The most practicable one that has thus far been suggested is its use in the manufacture of fire brick. The mineral has the properties necessary for a bond used in the manufacture of these bricks and a few preliminary tests already made with the pyrophyllite in the construction of a fire-brick, have shown that it can without doubt be adapted for this purpose. With brick factories in the vicinity of the deposits it is not improbable that that portion of the pyrophyllite that is not suitable for grinding may be used in the manufacture of a fire-brick.

Certain portions of the pyrophyllite deposits are hard and compact enough to be used in the manufacture of slate pencils, and as far back as 1862 it was mined for this purpose.

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1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by Joseph A. Holmes and J. Volney Lewis. *In preparation.*

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20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 4.

THE MINING INDUSTRY

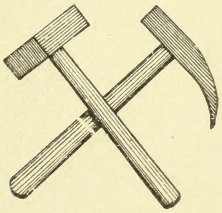
IN

NORTH CAROLINA DURING 1900

BY

JOSEPH HYDE PRATT

MINERALOGIST



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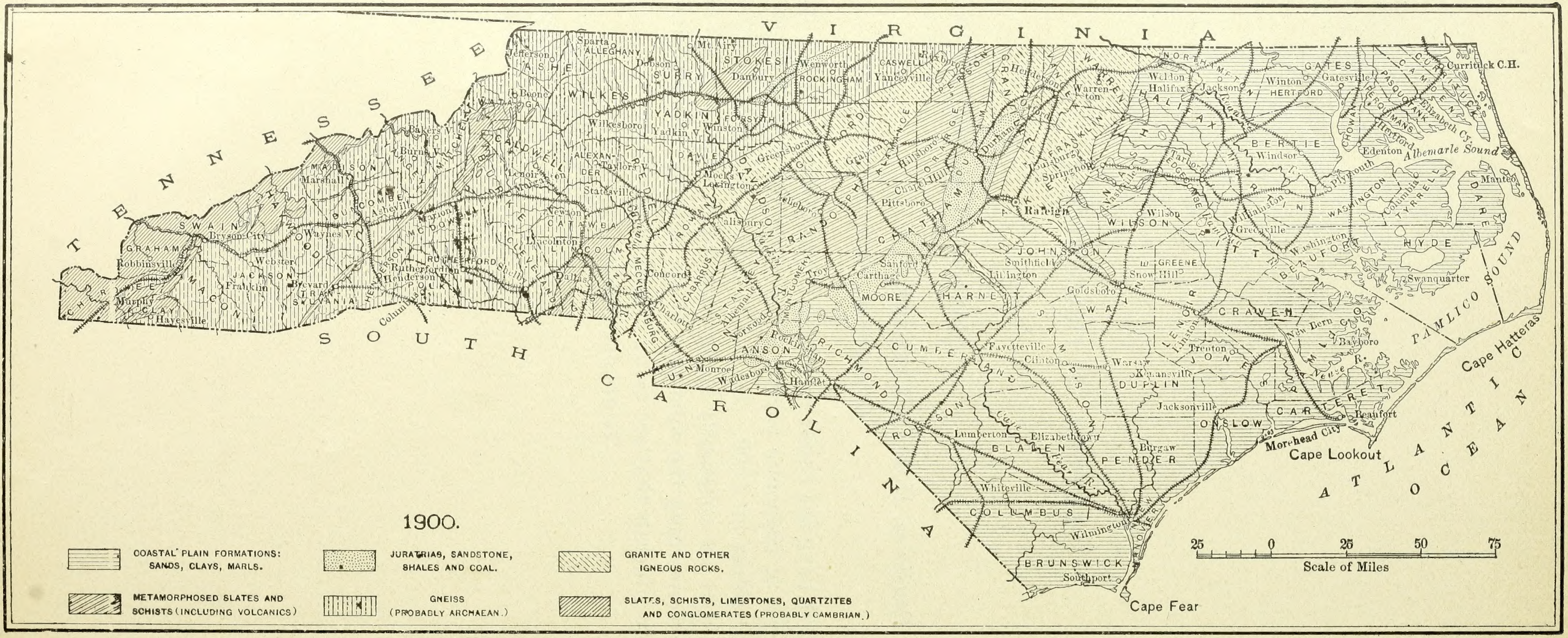
LETTER OF TRANSMITTAL.

RALEIGH, N. C., May 1st, 1901.

To His Excellency, HON. C. B. AYCOCK,
Governor of North Carolina.

SIR:—I have the honor to submit for publication, as the fourth of a series of economic papers, a report on the *mining industry* in North Carolina for 1900. Its publication is intended to meet inquiries that are constantly being received at this office for information concerning the condition of the mining industry and the different minerals that are being mined in the State.

Yours obediently,
J. A. HOLMES,
State Geologist.


VIRGINIA
TENNESSEE
SOUTH CAROLINA
ATLANTIC OCEAN
PAMLICO SOUND
Albemarle Sound
Cape Hatteras
Cape Lookout
Cape Fear
Currituck C.H.
Raleigh
Wilmington
Charlotte
Greensboro
Asheville
1900.
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN.)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN.)
25
0
25
50
75
Scale of Miles

SKETCH MAP OF NORTH CAROLINA SHOWING THE DISTRIBUTION OF THE PRINCIPAL GEOLOGICAL FORMATIONS.

MINING INDUSTRY IN NORTH CAROLINA DURING 1900.

INTRODUCTION.

The year (1900) that has just closed has seen greater activity in the development of mines and mineral properties in North Carolina than any during the past fifteen. This renewed activity, which was not unexpected, has not been confined to any one mineral, but has been general. In the report for last year attention was called to the large increase in the price of copper and iron, which was the cause of the re-opening of many of the old mines of these minerals in the State and started a systematic prospecting for new properties. The high price of copper has remained throughout the year, so that mining for this metal has continued to increase. With iron, however, there has been a decided decline and nearly all of the iron mines that were re-opened a year ago have shut down for one cause or another. In the gold fields there is about the same amount of mining as last year, but more of the mines are being systematically worked, and at others and also at new properties the development work is of a better class. The demand for the minor minerals, corundum, talc, mica and monazite is attracting unusual attention to the deposits of these.

There are many facilities favoring mining operations in North Carolina—such, for example, as cheap labor—although really skilled labor commands about the same price here as in other southeastern States; climatic conditions, which permit nearly continuous mining throughout the year; low cost of timber for lumber and cordwood; proximity to railroads and also centers of mining supplies, as Charlotte and Salisbury; and the abundance of water-power that is available at many of the mining localities, which would make practicable the installation of electric-power plants. But here, as elsewhere, mining must be carried on as a business proposition. Many of the failures in mining in North Carolina have been due to overcapitalization and either poor management or overmanagement. As renewed activity in mining has begun it is to be hoped that it will all be along legitimate lines and that speculative mining (especially that on paper) has had its day in North Carolina.

During the past century many new industries have sprung up that have called for certain minerals for their manufacture, and as this commercial demand arose for these minerals they have been found in large quantities where, in many cases, they were formerly supposed to be very rare. North Carolina has furnished many of these and she is one of the first States that is looked to when there is a demand for a new mineral. Every year minerals new to the State are being added to the list and frequently a new mineral species is discovered, thus constantly increasing the variety of minerals to be found within the commonwealth.

With the opening of the new century there is a most promising outlook for future mining operations in North Carolina, for never were the conditions more favorable for the development of her mines; and with capital seeking investment, the next few years should see a decided gain in this industry. Some idea of this future perspective is shown in the following pages, which take up in detail the mining operations for the various minerals as they have been carried on during the past year.

GOLD.

There have been a few new gold properties opened up and developed during the past year, but most of the work has been done at old mines, some of which have been operated quite extensively. In many respects it might be said that in gold mining the year 1900 has been one of development rather than actual mining. The larger part of what has been accomplished has been solid and systematic work, preparing for the actual mining that it is confidently expected will be extensively carried on during 1901.

Improved methods and machinery are making it more possible from year to year to use ores that were formerly supposed to be of little value or of a too refractory nature to be economically worked. It may not be out of place to mention here one machine that has

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recently been put on the market that will probably make possible the working of many gold properties that have had to be abandoned. This machine is the Hooper Pneumatic Concentrator, and the process of treating the ores is the Hooper Pneumatic System, which requires no water. The ore is crushed and then passed into a dryer, when required; then to a set of coarse rolls, from which it is taken by an elevator belt to the finishing rolls; from these it goes to the screens of three or more different mesh; then to the ore bins, from which it is fed to the concentrators. By varying the speed, the inclination of the table, the stroke and the feed, an almost perfect separation can be made. The discharge is so arranged that the concentrates go into one channel and the tailings into another. This process, while being peculiarly applicable in localities where water is scarce, is well adapted for the concentration or separation of all kinds of ore, and has been very highly recommended wherever employed.

As is well known, North Carolina was one of the first gold-producing States of the Union, and from 1799 to 1879, North Carolina had produced about $20,000,000 of gold. In the next ten years it did not average over $165,000 a year, and since 1890 the production has decreased very materially, some years being less than $40,000. This decided decrease in the production of gold is of course due to the working out of the richer placer deposits and many of the free-milling ores. Perhaps the most feasible gold mining properties in the State are the large deposits of low grade ores, both free-milling and sulphuret. These, however, must be of sufficient extent to warrant the establishment at or near the mine of a plant for mining, milling and reducing the ores. Sometimes it may be possible to work under one management a number of these low grade ore deposits that are in the vicinity of each other, where they would not be profitable when worked as separate mines. It is usually a question of quantity with these low grade ores that determine their economic value. A thorough study should be made of each deposit to determine the most practicable method for treating the ore. It is very probable that a large concentrating and reduction plant, centrally located, to which the ore could be shipped either before or after concentrating, would be kept busy all the year and make a profitable investment. The ore would be bought according as it assayed.

There has been but very little mining carried on at the gold deposits in what is known as the Eastern Carolina Gold Belt, which includes those of Warren, Halifax, Franklin and Nash counties. Most of this work has been done at the mines in the vicinity of the Portis, Nash county. The principal work being near Ransom's Bridge, where twenty men have been at work for about six months sluicing.

On several plantations in the vicinity of Lyndover, Durham county, there has been some prospecting for gold, and on W. M. Blalock's property, several shallow shafts were sunk, which he reports encountered veins carrying gold, but that not enough work has been done to determine their extent or value.

In Rowan county, there has been the greatest activity. There are now in the vicinity of Gold Hill two companies that are equipped and in a position to mine and treat the low grade ores of this section on a large scale, which is absolutely essential if they are to be made to pay. Besides these there is a third company who will soon be in a position to handle these ores in the same way. The Gold Hill Copper Company's property, including the Randolph mines, join those of the Union Copper Company in the southern part of Rowan county and extending into Stanley. Over $35,000 have been spent in equipping the mine, the plant now including a 20-stamp mill and 5 Wilfley tables. While as yet no ore has been shipped, it is expected that work will soon be resumed and that ore will then be taken out on a large scale. Besides gold, nearly all the ore from Gold Hill carries some silver and copper; and in some instances the ore becomes of more value as a source of copper than of gold, which is the case of the mines belonging to the Union Copper Company, described under copper. The Whitney Reduction Company are operating the McMakin mine at Gold Hill and report considerable success. Their mine is thoroughly equipped with an Ingersol compressor plant, capacity of 6 drills; with hoisting engines, and Cornish and Cameron pumps. There is in operation at the mine a 10-stamp mill and Wilfley tables having a capacity of 10 tons per day; and a complete roasting and chlorination plant. The work that has been done the past year is called development work and consisted of driving 2,000 feet of levels; 1,200 feet of rises and cross-cuts and the sinking of 1,004 feet of shafts. In this development work there were 15,000 tons of ore taken out. Later on the company expects to erect a stamp mill and reduction plant having a capacity of 1,000 tons per day.

At a number of mines in Guilford county a small amount of work has been done, but nothing of any special importance has been accomplished. The principal work was done at the Deep River and Lindsay mines.

In Davidson county there has been considerable activity in prospecting and developing some of the old mines. The Silver Hill and Silver Valley mines still attract a great deal of attention and are being investigated by New York people. While the ores taken from these mines have been principally silverores, they contain more or less gold. The main part of the unaltered ore is made up of a mixture of sulphides galena and sphalerite sometimes intimately associated with each other. There is more or less pyrite in the vein, which is often in pockets or bunches. Assays made of the ore from various points in the Silver Hill mine gave values from a trace up to $507 per ton. The higher values were from the bunches of pyrite referred to. The regular mixed sulphide ore gave usually values of from $4 to $12 per ton; but some showed only a trace of gold. Prospecting has been carried on quite vigorously in the vicinity of Cid post-office by the Southern Mining and Development Company, and they have opened up a number of deposits that show ore similar to that of the Silver Valley and Silver Hill mines. At a number of their openings the copper sulphide, chalcopyrite, predominates. The Ward mine, about one and a half miles east of Cid, was worked a little during the last six months.

There has been but little mining in Randolph county during the past year. The Jones or Keystone mine, 12 miles south-southeast from Thomasville, has been worked to a limited extent, but no definite results were accomplished. Work at the Sawyer mine, 5 miles west of Sophia, on the Ashboro branch of the Southern Railroad, was begun in June; but early in July their water supply began to give out and grew worse all summer, and it was not until December that there was sufficient water to run the plant regularly through the month. The work done at this mine during the past two or three years gives indications of some promise for this mine, and the owners expect to push work during the coming year.

In Montgomery county a little prospecting and some placer work has been carried on. Owing, however, to the drought during the summer, there was an insufficient water supply and work was stopped. There are, without doubt, placer deposits in the northeastern portion of the county that could be profitably mined. The Uharie river is available as a water supply, but a pumping plant would have to be installed to utilize it. In the Buck Mountain region, 7 miles from Troy, the placers have been tested and gave promising results. The Sam Christian mine was worked for a short time.

The mining done in Stanly county has been spasmodic and of little interest. A number of different persons have worked a few weeks to a month or two at a time. The Parker, Crawford and Fesperman mines are the only ones of any note that were worked. It is probable that there was about $1,000 of gold obtained altogether.

In Cabarrus county the most work has been done at the Reed mine, which is equipped with a 10-stamp mill, crusher, and steam pump, operated by a 20-horse-power portable engine. Mining has been carried on for most of the year, but it has been more in the nature of development work. Ore was encountered in the one shaft operated that assayed $25 to $30 per ton. The vein, however, is small and has been pretty thoroughly worked out to the depth of the shaft. Mining has been continued with some success at the Black Cat mine, which is also equipped with a 10-stamp mill, and at the Phœnix mine. Mr. C. G. Heileg, of Mt. Pleasant, reports the finding of gold on his property two miles from town, and that only sufficient work had been done to locate the vein.

Mecklenburg county also has been the scene of a considerable amount of activity in gold mining operations. The following mines have been worked the whole or a part of the year, some of them with considerable success: the Sommersville, McGee, Champion City, Grier (now Woolworth), Ferris, Garris, Surface Hill, Dunn, and Rudisill mines. At a number of these the work done has aimed to develop the property; and while considerable ore has been mined, none was smelted. At the Surface Hill mine a new shaft 75 feet deep has been sunk and the ore is reported to assay $22 per ton. No under-ground work has been done at the Dunn mine, and the ore that has been used was surface ore and that obtained from the waste of the sluice boxes. Where the vein was tested it gave values of $10 to $30 per ton. The Grier or Woolworth mine, three miles southwest of Charlotte, has been worked all the year, employing about 20 men. Two thousand tons of ore have been mined, but there are no facilities at the mine for smelting it. Assays reported show the ore to run from $9.40 to $264 per ton. An average of 17 assays gave $74.10 per ton. It is reported that the Rudisill mine has been sold and that the purchaser expects to begin mining on an extensive scale.

In Gaston county the Catawba River Mining Company are carrying on rather extensive placer mining, and also dredging, in which they are meeting with success. This company has also obtained mining rights for dredging in the Catawba and John rivers in Burke county.

The Shuford mine in Catawba county, four and a half miles south of Catawba Station, has been supplied with new machinery, and preparations are being made to work this mine at greater depths. Up to the present time it has never been worked deeper than eighty-five feet.

In the southern part of the South Mountain region the placer mining has been seriously interfered with by the lack of water, especially in the Brindletown area. Some little vein mining has been in progress, but mainly in the nature of prospecting. The northern part of the South Mountain region, in central Burke county, an area lying six to twelve miles north of Morganton, has been the scene of considerable activity and excitement. Rich quartz veins have been discovered here and companies are being organized to work them. The first vein of any prominence, and which attracted attention to this district, was encountered while sinking a well. Pieces of the quartz that were thrown out were een to carry free gold, and it was this that led to the region beings investigated.

The first company organized to develop and work these properties was the South Mountain Mining Company, which was incorporated under the laws of the State of Virginia with a capital of $250,000. This company now owns or controls about 2,000 acres, a portion of which is located six miles north of Morganton, and other tracts near Snow Hill, nine miles north of Morganton.

Most of the work that has been done by the company during the past year has been in the nature of development work, consisting of open cuts and shafts, which have been made at numerous points along the strike of four different veins that have been located on the property. From the four deepest shafts, which were twenty, twenty-five, sixty and seventy-five feet deep respectively, ore was taken for assay. These assays gave values from $15 to $200 per ton, the smaller assays being from ores taken from or near the surface, while the larger are from ores taken from near the bottom of the shafts. A mill test that was made upon 1,700 pounds of ore gave $42.83 per ton, while another mill test of 600 pounds of ore gave $104.50 per ton.

There are two types of gold deposits on the company's property: one in which the gold occurs in quartz fissure veins, and the other in which the gold occurs in the bands of the country rock, either in the form of free gold or finely divided sulphurets. The bands of country rock carrying gold are apt to be decomposed and stained by iron oxide and known locally as "brown ores;" and these are at the present time the principal ores that are being mined.

From results obtained from their development work the value of this property has exceeded the expectation of the company, and preparations are now being made to mine this ore on a large scale and to put up an extensive plant to treat the ore.

If these veins continue in depth and continue to carry the values already found, this property should become one of the most profitable gold mining properties in the State.

The Hercules mine, which is twelve miles north of Morganton, and is owned by Mr. Robert P. Orr, of Newport News, Va., is one that is giving probably the most favorable and promising results

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for the amount of work done of any mine in this region. Mr. Orr has developed this property by sinking a shaft on a quartz vein which was eight inches wide at the top and which was found to widen to thirty inches at the bottom of the shaft at a depth of fifty feet. This has been traced on the surface for nearly one-half a mile by means of open cuts and pits. At the twenty-five foot level a drift of one hundred feet was run on the vein from the shaft and it was found to be continuous throughout this distance. The ore that has thus far been taken out shows up remarkably well, and if the veins continue, as they appear to be doing, this will be one of the richest quartz mines known in the State. While as yet no assay has been made of the ore from this vein, it is very high, as indicated by the specimens showing free gold that have been taken out, every piece of quartz of which shows considerable free gold on it. About twenty tons of ore have been taken out altogether. This is probably but the beginning of what will be entensive mining in this district, and it is not at all improbable that as this section is more thoroughly prospected that still other good veins will be discovered.

Now that the richest of these placer deposits have been worked out it is only natural that the sources of this gold should attract attention, and from the richness of the placers it is to be expected that there will be found many quartz veins that will give very rich returns.

At the Martha mine near Hartland, two miles beyond the Hercules mine, there has been considerable placer mining and some mill work. The placers at the Martha mine were operated for five months with three men, and now the veins are being worked by hydraulic processes.

In Yadkin county the Huffman mine was worked for about four months and 150 tons of ore were taken out, which assayed from $5 to $50 per ton. The Kelly mine was worked for three months, during which time 40 tons of ore were taken out. It is expected that this mine will be worked during the coming year (1901).

There have been but few localities west of the Blue Ridge that have been worked for gold during the past year; but at the Boylston mine in Henderson county, the Canada Southern Mines

Company (Limited) carried on extensive work for ten months of the year, employing from 50 to 85 men opening up the different veins. A fully equipped and up-to-date crushing plant and 30-stamp mill have been erected, and so arranged that the ore is always handled automatically. There has been about 7,000 tons of ore mined during 1900. Assays are constantly being made by the company's assayer, and the average of 370 assays was reported to be $5.70 per ton; but this is probably somewhat higher than what the average ore mined will run. A ditch nearly a mile long has been dug to convey water from a reservoir on the mountain to the mill. This company expects to erect a chlorination plant, if the sulphide ores, when reached, warrant it. At their lowest workings pockets of sulphides are beginning to be encountered. In Cherokee county, about five miles east of Murphy, there has been considerable hydraulic mining in the placers of Valley river, which has met with some success.

The gold reported as being mined in the State during the (1900) is valued at $44,653; but the outlook for 1901 is that this production will be very materially increased.

SILVER, LEAD AND ZINC.

Workable deposits of silver ores are rare in North Carolina, and, though more or less silver is found in many of the gold and copper ores, no mines are known to the writer to have been worked during 1900 exclusively for silver. The Silver Hill mine at Silver Hill, seven miles from Lexington, Davidson county, which was re-opened during 1898 and worked quite extensively during 1899 by the West Prussian Mining Company, was shut down early in 1900. This and the Silver Valley mine are different from most of the mines in North Carolina in the character of the ore that they carry, which is a mixture of galena, sphalerite and pyrite. The first years the mine was operated successfully by reason of the amount of free silver obtained in working the decomposed and altered portions of the vein. As the mining was carried deeper the unaltered sulphides were encountered and mining became unprofitable. With the improved machinery for separating and concentrating ores and new metallurgical methods, it is not at all improbable but that these ores, if in sufficient quantity, can be worked profitably.

It is estimated that there has been mined in the State during the year silver to the value of $15,986.

COPPER.

There is still a great deal of interest being centered on the copper deposits and mines of the State, and, while but few of these have been producers the past year, they have in a number of instances been thoroughly developed and equipped; and it is not unreasonable to expect that 1901 will see North Carolina producing copper in considerable quantity.

The Union Copper Mining Company's mines at Gold Hill, Rowan county, have been worked most of the first half of the year, but owing to the company's having changed hands, mining was interrupted during the latter half of the year. The new company expect to work the mines conservatively and economically. While the ore is a low grade chalcopyrite (yellow copper), it exists in quantity. The ore occurs along certain lines or narrow zones in the chlorite and argillaceous schists and slates. These zones are impregnated with the sulphides (chalcopyrite, pyrite, and galena) which probably extend to considerable depths. The averages of sampling of ore by Dr. A. R. Ledoux* show the ore at the 130-foot and 150-foot levels to carry from 4 to 5 per cent. of copper, from 40 cents to $1.20 of gold, and from three to five ounces of silver. Most of the ore that has been mined has been piled at the mines, but little having been shipped and none smelted on the property.

The mine of the Peach Bottom Copper Company, near Elk Creek, Ashe county, is still being developed, a shaft having been sunk 107 feet, making a total of 1,000 feet of tunnels, shafts and cuts on the vein. Only a few tons of ore for sampling have been shipped; but the company expects soon to erect a reduction plant. The ore is reported to carry 4.8 per cent. of copper, $1.26 of gold, and $2.15 of silver. There are other copper properties in Ashe and Caldwell counties that have been prospected a little during the year, but not sufficient work has been done to enable any judgment to be passed as to their value.

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*Engineering and Mining Journal, February 10, 1900.

The copper region of Person and Granville counties has been the scene of considerable activity and this is probably the richest copper district in the State. At most of the mines in Person county the copper ore is the mineral chalcocite, and is known as gray copper, while that at the mines in Granville county is the mineral bornite, known as peacock copper. There have been a number of mines opened and operated in this region, all of which lie near the line between the two counties, the most important of which are the Holloway, Gillis, Copper World, Yancey and Tingen mines in Person county, and the Blue Wing mine in Granville county. At the Blue Wing mine, which is owned by the Boston and Carolina Copper Mining Company, there has been no work done during the past year, but it is expected that operations will be resumed during the spring. This mine improved in depth and at the end of 1899 had made one of the best showings of any of the mines in the district.

The Holloway mine is still the largest producer and during the past year has been about the only mine shipping ore. This mine is owned by Mr. W. E. C. Eustis, of Boston, Mass., who also owns other copper properties in this district. A smelter has been erected at Norfolk, to which the ore is shipped. This is the most extensively developed mine in this copper region, and, while it represents a private enterprise, it is also one of the most successful mining plants in the State. About 100 persons are employed and the work has been carried on throughout the entire year. If more mining operations in the State were carried on in a similar manner to that employed at the Holloway mine, there would be fewer failures of mining companies and the mining interests of the State would be rapidly increased.

Near the southern end of this copper belt is the Tingen mine, which is 8 miles east of Roxboro. This mine has been developed to a considerable extent during the past year, with encouraging results, and it is expected that work will be begun at the mine early in the spring (of 1901) by New York parties.

With increased railroad facilities there would be in this region a copper camp of considerable importance, with all the necessary equipment for the reduction of the ore. There are a number of the smaller copper properties which could be worked profitably if they had a smelter at hand to which they could ship their ore. The amount of copper ore that has been mined in the State and shipped during the year amounts to about 6,948 tons, valued at $41,600.

IRON.

There has been a very sharp decline in the production of iron ore during 1900, as a result of the drop in price of pig-iron, and consequently practically all but one of the iron mines in the State have suspended work. The cost of mining and transportation difficulties have been the causes of some of the mines being closed. The large blast furnace of the Empire Steel and Iron Company of Greensboro, which was the place of shipment of most of the iron ore mined in the midland counties, was shut down and this stopped the ore shipments. At the Chapel Hill mine a great deal of development work was done and it was thoroughly equipped with modern machinery and connected by a gravity railroad with the Chapel Hill branch of the Southern Railroad. It was from this mine that the Empire Steel and Iron Company had expected to draw a considerable supply of its ore. About 500 tons of ore were mined before the plant shut down.

At the Ormand mine of the Ormand Mining Company at Bessemer City, in Gaston county, considerable development work was carried on and it was equipped with new boilers and compressed air drills. No ore has been shipped and the mine has been obliged to close on account of the shutting down of the Greensboro furnace.

In Ashe county, where there are a number of extensive iron deposits, the most noted of which is perhaps the "Ballou," prospecting was carried on quite vigorously and a little development work was done, but the absence of transportation facilities will prevent any active mining of these deposits for some time to come.

The Virginia Iron, Coal and Coke Company, which mined the iron ores of Cherokee county quite extensively during 1899, has not mined any ore during 1900, owing to the low per cent. of iron in the ore. The whole region was prospected, but no new deposits were found that warranted further mining operations at present prices.

At Cranberry, Mitchell county, the Cranberry Iron and Coal Company have worked their mine of magnetic iron ore continuously throughout the year. This is the best known iron mine in the State, and has been operated almost continuously since that company has owned it. Besides the actual mining the company started some development work which more than met their expectations. In order to determine the direction of the deposit or the dip, a slope some twelve feet wide and eight feet high was sunk in the old underground workings, which is now one hundred and fourteen feet long and with an inclination of about fifteen degrees. For nearly one hundred feet back from the present head of the slope no dead rock was taken out, all the material taken out being good ore. It is intended to drive this slope one hundred feet farther at about the same inclination if the ore continues, and then to stope out the ore upward. The outlook at this mine for the coming year is most favorable.

The iron ore mined in the State during the year 1900 amounted to 21,000 tons.

MANGANESE.

Prospecting is being carried on near Brevard, Transylvania county, for manganese. While as yet no large deposit has been located, the ore (pyrolusite) is being tested by Pittsburgh parties who expect, if this shows up favorable, to develop the property. About two carloads of ore have already been shipped from this property.

PYRITE.

The mineral pyrite as sulphide of iron ($F_e\ S_2$) is used in the manufacture of sulphuric acid and has been mined quite extensively by the Carolina Pyrite Company at their mine four miles from Crouse, Gaston county. About 4,500 tons of hard lump pyrite were mined in 1900.

CORUNDUM.

Of the many good corundum mines in the State, there has been but one that has produced this mineral in any quantity during the past year. The main reason is that the best deposits have been owned by one company, which has been contented to operate but one of its mines. Other properties have been prospected with some success, and this prospecting is not now confined to the basic magnesia rocks, but has been carried on in schists and gneisses.

There has been a decided change in the companies controlling the various mines; all the corundum mines formerly owned by the Hampden Emery and Corundum Company have been bought by the International Corundum and Emery Company of New York; the mines of the National Abrasive Company of Philadelphia are now owned by a New York company of the same name; the deposits of corundum in the quartz schists of Clay county, North Carolina, and the adjoining Rabun county, Georgia, have been purchased by the Corundum Mining and Manufacturing Company of Philadelphia.

This latter company is making preparations to work the deposits of corundum in quartz schist on Scaly Mountain, in the southeastern part of Clay county. It has erected a complete crushing plant at the mine at an elevation of 4,500 feet, and a concentrating and cleaning mill 2,000 feet lower on the mountain. About 1,000 tons of ore have been taken out, but only a small amount has been cleaned in experimenting with different methods. The profitable mining and cleaning of this corundum offers some difficulties that it is hoped will be overcome.

The National Abrasive Manufacturing Company has a property on Caney Creek in Jackson county, where the corundum occurs in a mica and chlorite-schist. A little prospecting had been done and some of the ore cleaned, but not enough work had been done to demonstrate its actual value. The corundum is of good quality and the deposits indicate some promising results.

On the property of the Toxaway Company at Sapphire, Jackson county, massive corundum of good quality has been found near the Brockton mine, and is probably in the same formation of basic magnesia rocks as that found at the mine. Taken collectively the mines and corundum deposits of this company should be producers of a considerable quantity of corundum, and it is not at all improbable but that these mines will be worked in the near future.

It is the Corundum Hill mine at Cullasaja, Macon county, that has produced practically all of the corundum that has been mined in the State. All the work that has been done at the mine during the past year has been under the direction of the old Hampden Emery and Corrundum Company, but the new company, the International Corundum and Emery Company, expect to take hold of these mines soon and to work them to the best advantage, when their output should increase considerably. The corundum has been cleaned at Cullasaja and then shipped to Chester, Mass., where it was sized and prepared for the market. There has only been about 205 tons mined during the past year, but with the amount of this mineral that is known to be in the State and the demand that there is for it, there should be five times this amount produced.

GARNET.

This mineral has been mined at but one locality, the Sugar Loaf mine, near Hall, Jackson county. This mine is owned by the National Abrasive Manufacturing Company of New York, and has been worked at intervals for most of the year. The material is crushed and cleaned at the mine and then carried to the mill at Waynesville, where it is sized and prepared for shipment. It is sold under the name of ruby corundum.

A similar garnet occurs at the Pressley mine at Speedwell, Jackson county, and also at the Savannah mine, Cowee Mountain, in the same county, but none has been mined at either of these during the past year. It is expected, however, that work will be resumed at the former early in 1901. The garnet is in gneiss and occurs in bands cutting through the normal gneiss. It constitutes about 25 per cent. of the rock. The mining is all open cut work.

This garnet is probably superior to any garnet mined, and while it cannot replace emery or corundum, it does have a considerable use for special kinds of wheels and grinding. On account of its low fusibility, it cannot be used in the manufacture of the vitrified wheel, but is used principally in the chemical (silicate) wheel. The production for 1900 amounted to 300, tons valued at $18,000.

MICA.

The mica mines have been worked quite vigorously during the past year, but not as extensively as in some former years. Mitchell, Yancey, Haywood, Macon and Jackson counties continued to produce most of the mica that was mined in the State, and nearly all the important known mica properties in the two latter were worked for at a least a portion of the year. For many years the mining of mica in the State has been handicapped by the low price realized caused by the importation of the India and Canadian mica. The tariff on the larger sizes, especially, is not sufficient to furnish adequate protection. If it was not for the superiority of the North Carolina mica it would be difficult for it to compete with the foreign article. North Carolina mica is still, as it has always been, superior to any in the world for many purposes, and if the price of this were slightly increased and rendered more constant the production of mica would be much larger during the coming year. Nearly all the old mines that have been opened have been producing mica during the year in nearly as large a quantity as formerly.

Scrap mica, which has become a prominent commercial product and is worth from $8 to $10 a ton delivered at the railroad, has made it possible to work some of the mines that would otherwise have been unprofitable.

What mining has been done in Yancey and Mitchell counties has been done for the most part in a small way, no one mine being a very large producer. The Cloudland, Double Head, Hawkins, Clarissa, Spread Eagle, and Deake, are some of the more prominent mines that have been worked on a small scale during the year.

In Haywood county the Big Ridge mine, seven miles from Waynesville, and the Shiny mine, eight miles from Waynesville, were worked for twelve and five months respectively. The Big Ridge mine has probably produced more mica during the year than any other in the State.

Many of the mines in Jackson county have been in active operation for at least a portion of the year. The Long and Furguson mines were worked for about three months with some success, while the Frady and East Fork mines were very successfully operated for about six months. Besides these there were a number of other mines that were worked from a week to a month, producing altogether about $2,000 worth of mica. In the southeastern part of Jackson county, near Sapphire, the Toxaway Company have been developing mica mines on their property and report that in this work about 2,000 pounds of plate mica (rough) were taken out. On adjoining property, owned by Dr. C. Grimshawe, development work has also been carried on with similar success. It is expected that the coming year will see considerable mining for mica in this section of the county.

In Macon county there was not as much activity in mica mining as during 1899. The Lyle Knob mine, which has again changed hands, was worked less than six months and then not very vigorously. The Raby mine was only worked about two months. These mines were the main producers, as they were the year before. A few other mines have been worked spasmodically for a week or two at a time, with perhaps a production of about $1,500 worth of mica.

The Carolina Mining Company have been developing a mica mine on Beaver Creek, near Jefferson, Ashe county, and report that they expect to begin shipping mica early in 1901. They have employed 20 men for the past three months, and have erected a mica mill for grinding scrap mica.

The mica mines near Sandy Ridge, Stokes county, have produced about $1,000 worth of sheet mica during the year.

There has been a little mica mining in McDowell county, about 8 miles north of Marion, by Mr. John R. Cochran, of Durham, North Carolina. While most of the work done has been developing the mine, considerable good plate mica was taken out.

The total production of mica in this State for 1900 has been estimated at about $101,462, but it is difficult to get accurate figures. This value includes 5,945 tons of scrap mica valued at $36,262.

North Carolina State Library.

TALC.

All the talc that has been mined during the past year has been in Swain and Cherokee counties, and for the most part from the same mines that were the producers in 1899. The continued demand for good talc, in which North Carolina excels, has caused new properties to be developed and the celebrated Hillyer mine at Kinsey, Cherokee county, to be re-opened. This mine has been purchased by the American Talc Company and was re-opened in June, 1900. The company has erected new buildings thoroughly equipped with modern machinery for mining talc and preparing it for the market. Two new shafts have been sunk on the deposit and talc was encountered in each at a depth of forty feet, and at a depth of seventy feet they are still in solid talc. Drifts at a depth of sixty feet show the bed of talc to be seventy-five feet or over in width. The work done at this mine has put it in the best possible shape for producing talc in large quantities, which it is now able to do. During this development work about seven hundred tons of white talc have been mined. When in full operation this mining plant will give employment to about forty men. The talc from this mine is of the finest quality, but none is compact enough to be used in the manufacture of pencils.

The property of the Cherokee Iron, Marble and Talc Company, two miles to the east of Murphy, Cherokee county, has been thoroughly prospected by Mr. A. S. Emerson, of Baltimore, Md., with the result that a mining company was organized and is now working these deposits. He has also been mining at the Kinsey mine, owned by the Notla Consolidated Marble and Talc Company, which yields a product of the finest talc like that from the Hillyer mine. The other mines that have been producing talc are in Swain county and are the Hewitt Mine at Hewitt, operated by the North Carolina Talc and Mining Company, and the Nantahala Marble and Talc Company's mine at Jarretts, both of which have been working all the year. The talc from these mines is more compact than that from the others mentioned, and more or less of it, especially from the Hewitt mine, is suitable for cutting into pencils. Mr. Frank R. Hewitt, the manager of the North Carolina Talc and Mining

Company, reports that he has discovered another large deposit of talc on the company's property, and that this is now producing a large quantity of good talc.

The Maltby mine of the Southern Mineral Company at Tomotla, Cherokee county, which was a large producer in 1899, was not worked at all in 1900, although there is still a good deposit of talc at this place. It is expected, however, that work will be resumed at this mine during the coming year. There are other promising talc properties in this region that should raise the production of talc very materially. An economic paper has recently been published by the North Carolina Geological Survey that describes in detail these talc deposits* which can be obtained on application to the Survey office at Chapel Hill, N. C.

Nearly all the talc that is mined is used as flour talc, there being only about thirty tons that was compact enough to cut into pencils of various shapes. The production of talc is included with that of pyrophyllite.

PYROPHYLLITE,

This mineral, while possessing many of the physical properties of talc and often handled commercially under the same name, is different in its chemical composition, and is a distinct mineral species. Although pyrophyllite probably cannot be put to all the uses of talc, it can be used for the larger number of them, and for those in which talc is used in the greatest quantity. Some of it would be of value to cut into slate pencils, but its greatest value would be when ground to a flour.

The deposits of this mineral are in Moore and Chatham counties and have been known for many years. They are extensive and offer a promising field for profitable mining operations. During the past year mining for pyrophyllite has been carried on principally by the Rogers Creek Mining Company and the Fairfax Mining Company. The deposits of pyrophyllite on the Snow property have been developed by cutting across the deposit and exposing the mineral, considerable being taken out and a carload or two shipped as sample lots. These have proved satisfactory and it is expected that regular mining will be begun here early in the spring. The work done shows that this deposit is a continuation of that mined by the Rogers Creek Mining Company to the southwest and contains a large quantity of good mineral. These pyrophyllite deposits have been described in detail in a recent report of the North Carolina Geological Survey.*

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* Economic Paper No. 3, N. C. Geological Survey; Postage 2 cents.

As the mineral is sold and used as talc, its production is included with talc, and their total production during the past year was about 3,500 tons, valued at $42,000. These figures represent the value of the crude material and not that prepared for market.

GRAPHITE.

There has been many inquiries regarding the occurrence of graphite in North Carolina by those interested in obtaining deposits of this mineral. As yet there are no developed deposits of graphite in the State, but at Graphiteville, McDowell county, an extensive plant is being erected by the Connally Graphite Works to mine and manufacture the graphite that occurs in this section. The deposit of this mineral consists of an extensive series of bodies of graphitic schists in a country rock of mica-schist and gneiss. These schists vary widely in their percentage of graphite, some being very lean and others richer. These graphitic schists can be traced for a distance of about three to four miles in a northeast southwest direction, from Brush Mountain on the west to Fork Mountain on the east. The deposits first becomes prominent near Mill Creek trestle of the Southern Railroad. The best known of these is about two hundred and seventy-five feet wide, with a very lean streak of the graphitic-schist near the center. The deposit crosses up and down five ridges, each of which rise to a height of five hundred feet or more above the general level of this section of the country.

The aggregate amount of graphite in this deposit is enormous; but it presents certain problems in its purification which make it somewhat uncertain whether it can be profitably cleaned. Methods for separating the graphite in the schist have been experimented with by Dr. J. W. Ihne, and the method to be used by the company is known as the Dr. F. W. Ihne process. Thus far no graphite has been mined, but it is expected that the plant will be ready for work and mining begun in 1901.

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*Economic Paper No. 3, North Carolina Geological Survey, Chapel Hill, N. C.

Three miles north and west of Raleigh, Wake county, there is another series of deposits of graphitic schists similar to those of McDowell county, but they are more decomposed than the latter. Some work has been done on them at intervals during the past several years; and some graphite has been shipped, but the work has not been sufficient to determine their economic value.

In Macon county, on the land of C. D. Franks, of Franklin, graphite has been found of such purity that it has been cut into pencils and used by some of the lumbermen. Also on C. W. Slagle's farm, near Franklin, graphite of good quality has been found. These deposits have not been investigated, and at the present time would be too far from railroad facilities to be worked, but with the proposed railroad built across Macon county it would make them accessible.

The production of graphite in the United States is less than one-tenth of the amount of graphite used, the rest being imported from Canada, Bohemia, Ceylon and Germany. It is thus seen that there is a large opening for graphite mining, and with the demand and good prices for this mineral any new deposits near a railroad are worthy of investigation.

KAOLIN.

The only mining that has been carried on for kaolin in 1900 has been in Jackson county, where a number of mines have been operated. The Harris mine, near Webster, owned by the Harris Clay Company, continues to be the largest producer, putting on the market twice as much as all the others together. The other mines producing kaolin were the Kaolin Manufacturing Company of Waynesville, but whose mine is near Webster; the North Carolina Kaolin Company, near Addie, and the North Carolina Mining and Manufacturing Company at Sylva. About 250 men are employed in the kaolin industry.

There are other deposits of kaolin in the State that give promise of developing into mines of kaolin of good quality and quantity, but they are at the present time too far from railroad facilities to compete with the other kaolin mines. These deposits are near Franklin, Macon county; Marshall, Madison county; and North Wilkesboro, Wilkes county.

Near Hall, Jackson county, on the property of the National Abrasive Company, there is a kaolin deposit that shows up very well, and what little work has been done upon it indicates that there is a large deposit of good kaolin. It is near to railroad facilities; and present developments indicate that it may become an important addition to the sources of kaolin in the State.

The output for 1900 has been about 7,000 tons of kaolin, valued at $62,440.

GEM MINERALS.

There has not been any extensive mining in the State for gem minerals, the principal work that has been done being for rhodolites and beryls. The American Mining and Prospecting Company of New York have operated their rhodolite mine on Mason Branch, in Macon county, during September, October and November, working nine men, and obtained many good gems, the largest weighing, when cut, 4½, 10¾, and 13⅜ carats. These were all found in the Lowe placer rhodolite mine. One mile west of this place considerable work was done, where the rhodolites occur "in situ," and satisfactory results were obtained. At this "in situ" locality, iolite, bronzite and cyanite were found quite abundantly, associated with the rhodolite. The American Gem Company of New York worked three or four men for a short time on their property further down the same valley. As would be naturally expected, the rhodolites that they obtained were smaller than those found further up the valley. They took out, however, a considerable quantity of gem material.

The gem mine at Hiddenite, Alexander county, which has furnished so many beautiful hiddenites, beryls, emeralds, quartz crystals and rutiles, is expected to be re-opened and mining operations to be begun early in the spring.

The Littlefield beryl mine on Tesentee creek, Macon county, has been worked by E. E. Magee, with good results for the short time that the work was carried on. He worked four men for a month, making a cut 20 feet in length and 10 feet long, obtaining the good beryls only from near the bottom of the cut. Many good beryls of an aquamarine, yellow, golden and bluish color were obtained that would cut stones from a quarter of a carat to three carats in weight. Most of the beryl, however, will cut stones of from one-half to three-quarters of a carat in weight.

A few gem minerals from various localities are brought into Asheville from time to time, but the amount has been unusually small during the past year. The total value of the gem obtained during 1900, as far as reported, is $12,000.

MONAZITE.

There has been considerable activity in monazite mining during the past year and the outlook for 1901 is very encouraging. Demands are constantly being received for North Carolina monazite, and early in the fall of 1900 a letter from Mr. Frank H. Mason, American Consul-General at Berlin, appeared in the *Manufacturers' Record* in which he states that there is an increasing demand for monazite in Germany. The two following paragraphs are quotations from this letter:

"But the Brazilian monazite sand is now under a single control, with the result that its price has advanced until there is in Germany a real demand for a supply from another and independent source.

"I am applied to by Messrs. Zeitz & Bruno, No. 111 Chausseestrasse, Berlin, manufacturers of the highest grade of Welsbach mantels, who wish to be put into relations with the owners of the best Carolina deposits who are prepared to export their product in quantities."

North Carolina monazite is known in Germany and has been experimented with by their chemists with excellent results, it having been used before the introduction of the Brazilian monazite.

Considerable quantities of monazite sand have been mined and shipped during 1900 at remunerative prices. This was obtained principally from Burke and Cleveland counties by Mr. John R. Kirksey and others in the former, and by Mr. L. A. Gettys, Mr.

Robert Downs and the Campbell Monazite Company in the latter county. Most of the mining has consisted of the shoveling and washing of the gravel deposits in the bottoms adjoining the stream beds. The Campbell Company have erected a plant for the crushing of a gneissic rock carrying monazite, which is to be separated out by a washing process. The monazite industry furnishes labor to a considerable number of people in Cleveland, Burke and Rutherford counties.

Until an act was passed by the Legislature in 1898 prohibiting the use of Muddy creek in McDowell county for mining purposes, monazite was mined in this county by Mr. Henry C. Demming, of Harrisburg, Pennsylvania. Since then there has been little or no mining for monazite or gold in that region.

It is estimated that there has been mined in the State during 1900 about 454 tons of monazite, valued at $48,805.

TUNGSTEN.

The demand that has arisen during the past few years for tungsten has caused considerable prospecting for the minerals, scheelite, a calcium tungstate, and wolframite, an iron tungstate, which are the principal sources of this element. Of these two, scheelite is the more valuable on account of its higher percentage of tungstic oxide and because of the easier separation of this oxide in this type of ore.

The main uses of tungsten are in the manufacture of steels, the tungsten making the steel exceedingly hard and tough and superior to any other steel manufactured. Projectiles made out of tungsten steel have penetrated through 14 inches of the best armor plate. It is beginning to be employed in the manufacture of tool steel and spring steel; tools made of tungsten can be driven much faster in cutting other metals, and the tungsten spring steel has more carrying power than those made out of ordinary steel. In using it in sounding plates and wires for pianos it gives them additional strength and quality.

There are but few localities in America where these minerals, scheelite and wolframite, are being mined, the principal ones being at Long Hill, Connecticut, Dragoon Mountains, Arizona, and San

Juan and Boulder counties, Colorado; but the demand for them is causing those interested to look to other States as a source of supply. These minerals were formerly considered of somewhat rare occurrence and of no commercial value; but now they are beginning to be found in quantity and at many localities.

They are usually found associated with crystalline rocks and imbedded in quartz. Wherever scheelite is found, there is generally some wolframite and the latter is very often a pseudomorph of it. The scheelite is a very heavy white to yellowish-white mineral, with an adamantine luster. Its specific gravity is 5.6 to 6.1; and its hardness 4.5 to 5, being readily scratched by a knife point. The wolframite on the other hand is a very heavy, nearly black, mineral, with a sub-metallic to resinous luster. Its specific gravity is 7.2 to 7.5, and its hardness is 5 to 5.5.

In North Carolina scheelite has been found at the following mines in Cabarrus county: Flowe mine in yellowish crystals; at the Cosby mine in yellowish crystalline masses; and at the Cullen mine in rounded granular patches of a grayish-yellow color. Wolframite has also been found associated with the scheelite at these mines. At the time these minerals were found at the above mines there was no importance attached to them and it is not known in what quantity they occur. Owing, however, to the value of the scheelite, about $300 per ton, these occurrences are worthy of investigation. Wolframite has been reported as occurring in some quantity on the Cheek farm, near Henderson, Vance county.

The tungsten minerals, on account of their high specific gravity, are readily separated from their associated minerals and matrix. The Hooper Pneumatic Machine, mentioned on page 9, is very well adapted to treat these tungsten ores satisfactorily.

If the occurrences of these minerals in North Carolina show themselves to be of value as a source of tungsten they will add considerable to the value of the mining in the State.

RARE MINERALS.

There is occasionally a demand for small amounts of the minerals samarskite, gadolinite, etc., containing the oxides of the rare earth elements, and for zircon and uraninite to use in experimental chemical work. About fifty pounds of zircon have been obtained from the zircon locality near Zirconia, Henderson county, and about ten pounds of samarskite from the celebrated Wiseman mine, near Spruce Pine, Mitchell county. Recently a locality has been discovered near Spruce Pine that indicates the existence of large quantities of samarskite.

BUILDING STONE.

There has been a steady increase in the production of stone during the past year, and there is a growing demand for North Carolina granite outside the State as well as within it. The Mount Airy granite quarries continued to increase their production over that of previous years, and are still the largest producers in the State. The Faith granite quarries, near Faith, Rowan county, have begun to be worked, and although as yet on a small scale, they have much in their favor for becoming a business of importance if the stone is properly selected.

The Rowan Granite Company have quarries located at Granite Station on the Yadkin Railroad four and a half miles east of Salisbury. They have completed a plant for the manufacture of railroad ballast, which has a capacity of twelve cars per day; also a large cutting shed, 60 by 120 feet, for dimension stone work, this being equipped with traveling crane, derricks, etc. The year 1900 is the first that the quarry has been operated, and the company expect to carry on the work on a more extensive scale in 1901.

C. A. McGalliard & Son, of Winston-Salem, have developed their new quarry in Rowan county, on the Mocksville division of the Southern Railroad, and have taken out during 1900 about five hundred cubic feet of what is known as blue pearl granite. The stone is of a fine rich dark color that takes a splendid polish, and there is sharp contrast between the polished and unpolished surfaces. While this stone may be too dark for building purposes, it should make a very handsome monumental stone and could be used with good effect as a trimming stone in buildings. As this stone becomes known its production will undoubtedly be largely increased and continue to grow.

The granite quarry at Balfour, Henderson county, has been operated by the Balfour Quarry Company with considerable success, as has also their quarry at Concord, Cabarrus county, which has been equipped with a new plant during 1900.

A beautiful "orbicular granite" is found on the Coolomee plantation, property of Mr. Frank Hairston, about two miles from Fork Church, Davie county. The granite consists of a ground mass of quart and feldspar in which are imbedded rounded masses of a radiating green augite which are at times more than an inch in diameter. The stone takes a good polish and wears well. It will make a very handsome and unique decorative stone. The deposit is being developed to determine its extent.

The brownstone and gray sandstone quarries, two miles south of Sanford, Moore county, were worked for eleven months last year by Carrington and Gonella, employing from 5 to 10 men. The plant has been increased by a new derrick and hoisting apparatus erected at a new quarry opened last year. This company have taken out about 8,500 cubic feet of stone.

An industry that will probably be increased during the next year or two is the marble quarrying in Cherokee county. Associated with all the talc deposits of this county are beds of marble, some of which are of the finest quality. While there is but one of them that is being quarried at the present time, the others are being prospected, and some splendid deposits are being located. The Notla Consolidated Marble and Talc Company have been working a large part of the year at their quarry at Kinsey. They have four channelers at work and are taking out some splendid blocks of blue, pink and white marble.

The total amount of stone quarried for all purposes during last year was valued at $249,000 and this makes a very creditable showing for this industry and places it at the head of the various mining industries in the State.

COAL.

The coal mines of North Carolina are all in the Deep river district of Chatham county, between Gulf and Cumnock; and while it cannot be called an extensive coal-field it does offer possibilities of

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remunerative coal mining. There are beds of coal of good quality that range from about six inches to four feet in thickness, but with a probable workable average of 22 to 24 inches. The most serious obstacles in mining this coal are: the narrowing and pinching of the coal to thin seams; and the variation in quality, the wider beds being very apt to be more slaty; the intersection of the coal beds by trap dikes; and the absence of coal from some portions of the area. For these reasons no large prices have been paid for coal lands in this district; and mining should not be undertaken until the tract had been thoroughly tested by boring. A local State market can be obtained for all the coal mined in this district, if only the good quality is sold and its reputation kept up.

The Cumnock mines of the Chatham Coal and Coke Company at Cumnock are the only ones that have been operated during 1900; and during this year 18,000 tons of coal were mined.

Mr. Joseph W. Thompson, of Philadelphia, has recently purchased the plant of the North Carolina Coal and Coke Company at Gulf, and is making preparations to work the coal beds on a large scale. No coal was mined by the company during 1900, and the work done was confined to prospecting and developing.

SUMMARY.

While the total output of the different mines is perhaps not as large as expected, yet the past year has made considerable advance over that of the year before and the outlook for 1901 is better than it has been for many years. There are more mining properties in shape to do good systematic and profitable work than ever before, and there are prospects of greater activity in the gold, corundum, and talc mining, and in the stone quarrying. The copper mines are in better shape than they have ever been since they were opened to become large producers in 1901. Nearly all those now interested in the active mines and mineral properties of North Carolina report that the outlook for the coming year is very encouraging for an increase in all branches of mining. It is not then unreasonable to expect that the results at the close of 1901 will be far better than what they show at the close of 1900.

In the following table there is given the production of the different minerals that have been mined in North Carolina during 1900, together with their estimated value:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEAR 1900.

Mineral.	*Amount.*	*Value.*
Gold		$ 44, 653. 00
Silver		15, 986. 00
Copper	6, 948 tons	41, 600. 00
Iron	21, 000 "	42, 000. 00
Pyrite	4, 500 "	14, 625. 00
Corundum	205 "	36, 840. 00
Garnet	300 "	18, 000. 00
Mica (Muscovite)		101, 462. 00
Talc Pyrophyllite	3, 500 "	42, 000. 00
Kaolin	7, 000 "	62, 440. 00
Gems		12, 000. 00
Monazite	454 "	48, 805. 00
Rare Minerals	60 lbs.	20. 00
Stone		249, 000. 00
Coal	18, 000 tons	22, 500. 00
		$ 751, 931. 00

BULLETINS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by Joseph A. Holmes and J. Volney Lewis. *In preparation.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and Geo. B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 2 cents.*

8. Water Powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. Mica Deposits and Mica Mining in North Carolina, by Joseph A. Holmes. *In preparation.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. Corundum and the Peridotites in Western North Carolina, by J. H. Pratt and J. V. Lewis. *In preparation.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS, No. 1, on the Maple Sugar Industry in Western North Carolina; No. 2, on recent road legislation in North Carolina; No. 3, on Talc and Pyrophyllite Deposits in North Carolina; No. 4, on the Mining Industry in North Carolina for 1900, are also distributed free, on the payment of postage, 2 cents in each case.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

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NORTH CAROLINA GEOLOGICAL SURVEY

Economic Papers, No. 5.

HIGHWAY COMMISSION, BULLETIN No. 1.

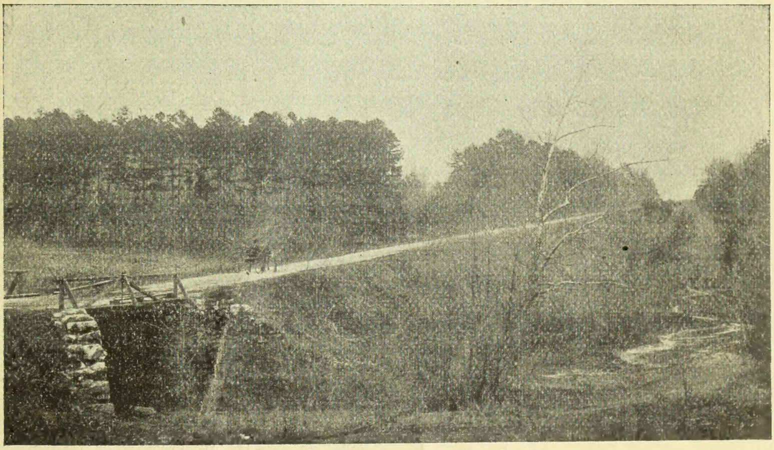
RECENT ROAD LEGISLATION

IN

NORTH CAROLINA.

BY THE

NORTH CAROLINA HIGHWAY COMMISSION.



THE OLD ROAD AND THE NEW IN MECKLENBURG COUNTY.

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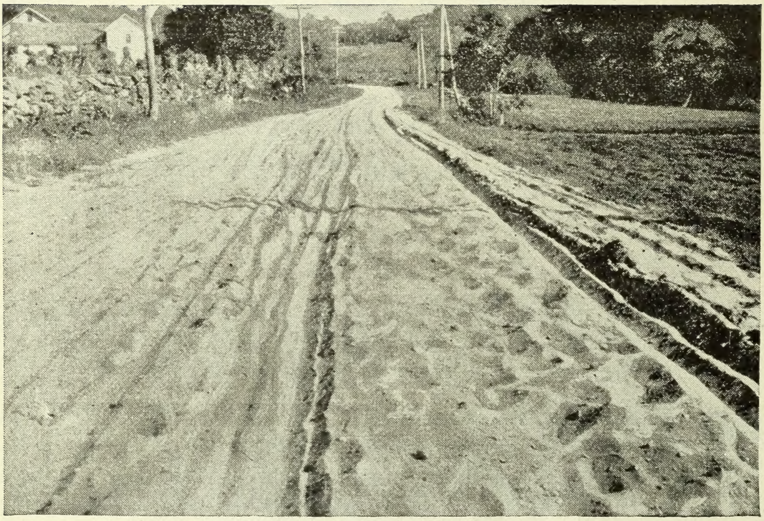

A deep sandy road which can be easily and cheaply changed into a good one by the addition of a top dressing of clay.

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Gift of

A good road made in a region of deep sand by an admixture of clay and a thin layer of oyster shell on top.

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LETTER OF TRANSMITTAL.

To His Excellency, HON. CHARLES B. AYCOCK,
Governor of North Carolina.

SIR:—In response to a general demand for the same, I have the honor to submit for publication by the Survey the fifth of a series of economic papers. Inasmuch as this relates to the recent legislation in North Carolina relative to public roads, highways and bridges, I recommend that it be issued as Bulletin No. 1 of the State Highway Commission.

Yours obediently,
J. A. HOLMES,
State Geologist.

NORTH CAROLINA HIGHWAY COMMISSION.

S. L. PATTERSON, Commissioner of Agriculture ------ Raleigh.
J. A. HOLMES, State Geologist ------ ------ ------- ---- Chapel Hill.
Secretary, T. K. BRUNER ---- ------ ------- ------- ---- Raleigh.

RECENT ROAD LEGISLATION IN NORTH CAROLINA.

An examination of the acts of the last several General Assemblies in North Carolina shows that a considerable advance is being made in the matter of legislation looking to the improvement of the public roads in the State. This is, of course, what one would expect as an outgrowth of the good roads movement of the past few years. Indeed, in view of the extent and the success of this movement in many directions the remarkable fact is that so large a proportion of the counties in North Carolina still insist on continuing in the old ruts, pretending to keep up their public roads by a labor system which every other civilized country has long since abandoned.

The general Assembly of 1901 was, in the matter of road legislation, an advance upon that which preceded it. It enacted special laws providing for the issuing of bonds for municipal improvements in some thirty different towns; it enacted either new special road laws or amended existing road laws—generally for the better—for some thirty different counties, including Franklin, Pasquotank, Person, Jackson, Davidson, Graham, Haywood, Union, Mitchell, Alamance, Warren, Catawba, McDowell, Macon, Madison, Anson, Iredell, Pender, Wilkes, Wake and Charlotte township in Mecklenburg county; it enacted special laws submitting to a vote of the people the question of issuing bonds for road building purposes in eight counties, including Rowan, New Hanover, Gaston, Mecklenburg, Catawba, Wilkes, Granville and Orange; it provided for special bond issues in a number of counties for the purpose of building and repairing bridges. It granted charters for the building with a plan for State aid two most important and greatly needed turnpikes, one connecting Mitchell and Yancey counties with the Western North Carolina Railroad at Marion, and the other connecting Ashe county with the railroad at Wilkesboro, both turnpikes to be built under the supervision of the Highway Commission. It revised and extended the provisions of the general road law of 1899 and it adopted a new general law, published herewith, which may be designated the new Mecklenburg Road Law, which in its first two sections provides for the establishment of a long and greatly needed State Highway Commission.

THE NEW MECKLENBURG ROAD LAW.

The original Mecklenburg Road Law, which was the beginning of modern road legislation in North Carolina, was drawn by Captain S. B. Alexander, of Charlotte, as general road law for the State, but was adopted by the General Assembly of 1879 for only three counties—Mecklenburg, Forsyth and Stokes. It was repealed by the following Legislature (1881) for each of these counties. It was re-enacted by the General Assembly of 1885 in a somewhat modified form, for Mecklenburg county alone. Since that time it has entered largely into the road legislation for various counties and has exercised a lasting influence for good on the road legislation in North Carolina. It was, however, more especially a township system of road management; and for some years, even in Mecklenburg county, it has been more or less modified and has been supplemented by the general State law which provides for the use of convicts in road-building under the county commissioners—under which general law the splendid macadam roads in that county have, in the main, been built.

The new Mecklenburg Road Law, enacted by the General Assembly of 1901, and herewith published (pages 3–26) has also been prepared by Captain Alexander. It retains as a foundation much of his original law which provides for the management of the ordinary earth roads in each township by a board of three "road trustees" to be elected by the magistrates in each township. It further provides for the management of the highways (or improved public roads), bridges and fords by the county commissioners, who are authorized to levy taxes and to use convict labor; and it further provides for a State Highway Commission, which shall in an advisory capacity give every possible aid to the township and

North Carolina
State Library.

county authorities in connection with the work of bettering the public roads. Sections 1 and 2 of this law providing for a State Highway Commission are made to apply at once to the entire State. The remainder of the law, at the time of its ratification, was made to apply to Mecklenburg county only, but it may become a road law in any other county in the State when adopted as such by the board of county commissioners in each county, excepting the counties specially named in section 78 of this act and the additional counties of Catawba, Durham, Gaston, Granville, Lincoln, Orange and Wilson, in which latter counties the general road law of 1899 is in force.

THE GENERAL ROAD LAW OF 1899.

The general road law of 1899, which as ammended by the General Assembly of 1901, is puplished on page 29 of this pamphlet, now applies to the list of counties given in Section 22, page 39. This law has many features in common with the Mecklenburg road law but differs from it mainly in placing the entire management of the building and repairs of the public roads, highways and bridges with the county commissioners, who select the superintendent and supervisors for the road work on both county and township roads, except that in cases where the people of any township vote an additional tax for road building in that township, the people of such township may designate the special commission to control the road work so provided for. Like the Mecklenburg law this one also recognizes the State Highway Commission and provides that the commission shall furnish plans and specifications for road improvemnt and shall be the interpreter of the specifications given in the law itself.

NORTH CAROLINA HIGHWAY COMMISSION.

The first two sections of the road law given on page 3 of this pamphlet provide for the establishment of the North Carolina Highway Commission, consisting of the Commissioner of Agriculture and the State Geologist. The commission has organized, electing Mr. T. K. Bruner as its Secretary, and will do everything within its power to aid the good roads movement in North Carolina. Its duties are set forth in the act referred to.

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An Act to Provide for the Better Working of the Public Roads and Highways of the State, as Amended by the Legislature of 1901.

The General Assembly of North Carolina do enact:

Tax to be levied for road purposes.

SECTION 1. That the board of county commissioners in each of the several counties coming under the provisions of this act shall, in order to provide for the proper construction, improvement and maintenance of the public roads of the county, at their regular meeting in June, of each and every year, and it is hereby made their duty to levy a special tax on all property subject to taxation under the State law in said county of not less than 5 cents, nor greater than 25 cents on the $100 worth of property, and not less than 15 cents nor greater than 75 cents on the poll; the constitutional equation to be observed at all times; said taxes to be collected as all other taxes are, to be kept separate in the tax books of the county, to be set aside as a special road fund to be used in the construction, improvement and maintenance of the public roads of the county, the purchase of such material, implements, teams, wagons, camp outfit, quarters or stockades, for the use of and safe keeping of the convict force as may be found necessary in the proper carrying out of this work, and for the employment of such additional labor as may be deemed necessary: *Provided, however*, that the moneys raised under this section shall, as far as possible, be used for permanent improvements.

Money to be spent for permanent improvements.

Election of road superintendent.

Constant and responsible oversight of roads.

SEC. 2. That there shall hereafter be elected by the board of county commissioners at their regular meeting in June, 1901, and at or before their regular meeting in January of each and every year thereafter, a superintendent of roads, who shall be paid such compensation as may be fixed by the board of county commissioners, and to be paid out of the county road fund, and who, after January, 1901, shall hold office for one year, or until his successor has been elected and qualified, as provided for in this act: *Provided*, that the said superintendent of roads may be at any time removed by the board of county commissioners after having been given ten days' notice and a hearing, when in the opinion of the board there exists good and sufficient cause for such action; and for malfeasance or misconduct in office he may be removed by them without further notice than may be necessary in order to give him a hearing. It shall be the duty of said superintendent of roads, subject to the approval of the board of county commissioners, to supervise, direct and have charge of the maintenance and building of all public roads in the county, and he shall submit to the board of county commissioners a monthly report concerning the work in progress and the moneys expended; and he shall submit quarterly a report on the condition of the public roads and bridges, and plans for their improvements, and he shall include in this quarterly report an inventory of the tools, implements, teams and other equipments on hand.

Tools and implements.

roads of the county, as provided in section four of this act, may be supplied by the county road superintendent, and shall be paid for out of the road fund of the townships in which the said implements or tools are to be used:

Proviso.

Provided, that until the county road superintendent shall be able to supply the necessary implements and tools, he may, and is hereby empowered to compel any and all persons working on the public roads of the county to provide themselves with such implements as are commonly used, while working on said road, as the superintendent or supervisor may designate in his notice or summons as being necessary.

Preparation of a list of persons liable to road duty.

To be furnished to road superintendent.

Sec. 7. That on or before the fifteenth day of April of each and every year the county treasurer shall furnish to the road superintendent or each township supervisor an alphabetical list by townships of all persons who have paid their money requirement in lieu of the------days of road labor for that year, the said treasurer having as many such lists prepared as shall be needed; and the county road superintendent or treasurer shall furnish each township supervisor a copy of such list of all those who have paid for that year in his township or district, as provided in section four of this act. That the supervisors shall carefully list all persons of road age within their respective townships or districts, check off the names of all those found on the list who have paid money in lieu of their labor requirment for that year, and furnish to the commissioners or superintendent of roads copies of such lists of persons liable for road duty in each district, and those who have paid in lieu thereof. A list of such persons liable to road duty in each township, who have at any time during the year failed

Persons failing to work roads, what to be done.

to work on the public road after having been duly notified, or to pay as provided for in section four of this act, shall be within fifteen days submitted by the county road superintendent or township supervisor to a justice of the peace in the township in which such persons reside, and it shall be the duty of said justice of the peace to immediately issue his warrant for such persons and proceed against them according to law: *Provided, however*, that the defaulting party may be prosecuted at any time and by any citizen of the county.

All criminals under sentence and persons in jail to be amenable to road work.

Sec. 8. That all prisoners confined in the county jail, under a final sentence of the court for crime, or imprisoned for non-payment of costs or fines, or under final judgment in cases of bastardy, or under the vagrant acts, all insolvents who shall be imprisoned by any court in said county for non-payment of costs, and all persons who would otherwise be sentenced in said county to the State prison for a term of less than ten years, shall be worked on the public roads of the county: *Provided*, that in case the number of such persons in any county, at any time, be less than ten the commissioners of the county may arrange with the commissioners of any neighboring county or counties for such exchange of prisoners, during

If number is insufficient in one county, may co-operate with adjoining county.

alternate months or years, as will enable each such co-operating county to thereby increase the number of prisoners at work on the public roads at any given time And upon application of the said road superintendent of the county, or that of the chairman of the board of county commissioners, the judge of the superior court, or the judge of the criminal court, the justices of the peace and the principal officer of any municipal or any other inferior court, it shall be the duty of the said judge or justice of the peace, or said principal officer, to assign such persons convicted in his court to said road superintendent or road supervisor in any township making provision for the same, for work on the public roads of said county or township; all such convicts to be fed, clothed and otherwise cared for at the expense of the county or township, as the case may be: *Provided further*, that in case of serious physical disability, certified by the county physician, persons convicted in said superior, criminal or inferior court may be sentenced to the penitentiary or the county jail.

Proviso.

Persons from other counties may be compelled to work the roads under certain conditions.

SEC. 9. That when the commissioners of any county shall have made provisions for the expense of supporting and guarding, while at work on the public roads of the county, or any township thereof, a larger number of prisoners than can be supplied from that county, upon application of the commissioners of said county to the judges of the superior and criminal courts, the justices of the peace and the principal officers of any municipal or other inferior court presiding in any other county or counties which do not otherwise provide for the working of their own convicts upon their own public roads, shall sentence such able-bodied male prisoners as are described in section eight of this act from such other counties to work on the public roads of said county or townships applying for the same, in the order of their application; and the cost of transporting, guarding and maintaining such prisoners as may be sent to any such county or township applying for the same shall be paid by the county or township applying for and receiving them out of the road fund of each such county or township: *Provided*, that any and all such prisoners from such other counties may at any time be returned to the keeper of the common jail of such counties, at the expense of the county or township having received and used them.

Application for prisoners of another county.

Proviso.

Classification of roadways.

SEC. 10. For the purposes of this act the roads or ways of the county are hereby classified as follows:

Thoroughfares.

(a) The thoroughfares include the more important public roads which usually lead through two or more townships or counties and are extensively used by the traveling public. These become the highways of the county as they are properly graded and drained and have their surfaces improved by being covered with broken stones, gravel, shells or suitable admixture of sand and clay.

Branch roads.

(b) The neighborhood or branch roads are public roads which are usually to the limits of one or two townships and generally lead from neighborhoods or settlements to main thoroughfares.

Cartways.

(c) Cartways, which have no general public junction, are private ways opened up to allow one or more persons on foot, on horseback, or with any vehicle, to pass to and from his or her property through lands belonging to other parties in order to reach the public road.

Location and general improvement.

Information and advice concerning the location, re-location and general improvement of these public roads shall be furnished to the county authorities by the State Highway Commission. And the said highway commission is hereby made the interpreter of and may revise the specifications for road building provided in this act; and it shall further prescribe the general regulations for the management of prisoners working on the public roads.

Engineer and supervisor to construct roads.

SEC. 11. That the thoroughfares or highways as defined above to be improved or constructed in accordance with the provisions of this act, prior to the inauguration of any such permanent improvements on the road or highway to be so improved or constructed, shall be first carefully surveyed and located by an engineer or surveyor trained and experienced in such work, aided by the county road superintendent or supervisor and such assistants as it may be necessary for him to employ, the same to be paid out of the road fund of the county, for services and expenses, as may be agreed upon by the county commissioners. All such public roads or highways, where changed or hereafter located or re-located or widened, shall be given a grade nowhere greater than three feet in one hundred feet, in counties situated in Eastern North Carolina; five feet in one hundred feet, for counties situated in middle or Piedmont North Carolina; and six feet in one hundred feet in counties situated in the mountain region of the State; and they shall have a width of not less than twenty feet, clear of ditches, trees, logs and other obstruction: *Provided*, that where, in the opinion of an experienced and competent engineer, insurmountable obstructions make the grades just described impracticable, the grades may be increased to the extent of one foot in one hundred in either of the regions named in this section, for distances of less than fifty feet in one place: *Provided further*, that where the roadway must be located on the steep slope of a mountain its width shall not be less than sixteen feet between ditches, or where blasted out in hard rock the width of such roadway shall not be less than thirteen feet: *Provided further*, that these thoroughfares or highways shall have a right of way of forty-five feet wide, but the width of the road-bed within the limits here specified shall be decided by the board of commissioners. All such roads shall be thoroughly drained, and wherever it may be necessary to turn water across them this shall be done by putting in sewer pipes or other forms of covered drains or culverts. These thoroughfares or highways as they are improved under the provisions of this act shall be located at a distance from any railway line of not less than three hundred (300) feet, except in cases where in the opinion of an experienced engineer a nearer approach to said railway line for a few yards be necessary. They shall cross said railway line only when, in the opinion of such engineer, this be necessary; and at such crossings, whenever possible, the roadway shall be located either under or over the said railway line; and it shall be the duty of the company operating the said railway line to construct and keep in good repair the road-bed, including necessary bridges or culverts, of such thoroughfares or highways across the right of way occupied and claimed by said railway company, this precaution being taken as a proper safeguard to life.

Proviso.

Proviso.

Width of road.

Distance from railways.

SEC. 12. The neighborhood or branch roads, as defined in section ten of this act, shall have a right of way of thirty feet; but the width and grade of the roadway, and specifications under which these roads shall be kept in repair, shall be decided by the county superintendent of roads or the supervisor in that township or district, subject to the approval of the board of county commissioners; and said roads may be re-located or otherwise changed in the manner provided for in section fifteen of this act. The amount and nature of the labor to be performed under sections four, five, six and seven of this act, in the maintenance and repair or change of any one of these roads or parts thereof, shall be at the discretion of the superintendent or supervisor in charge of said roads.

Branch roads, provisions for.

SEC. 13. Cartways, defined in section ten of this act, are to be kept in repair by parties using the same. Any party desiring a cartway opened up over lands of other persons may file his petition for the same before the board of county commissioners through the road supervisor of the township or district in which such cartway is to be located, praying for a cartway to be kept open across such other person's land, leading to some public road; and upon his making it appear to the board that the owner or owners of said lands, or their legal representatives, have had ten days' notice of his intention, the board shall hear the allegations of the petitioner and the objections, if any, of the owner or owners or their representatives, and if sufficient reason be shown shall order the constable or other officer to summon a jury of five freeholders to view the premises and lay off a cartway not less than fourteen feet wide, and assess the damages, if any, the owner of such land may sustain thereby, which, with the expense of making the way, shall be paid by the petitioner; and the way shall be kept open for the free passage of all persons, on foot or horseback, carts and wagons. Cartways, laid off according to the provisions of this section, may be changed or discontinued upon application by any person concerned, under the same rules of proceeding as they may be first laid off, and upon such terms as to the board of county commissioners shall seem equitable and just. And any person through whose land a cartway may pass may direct gates or bars across the same; if any person shall leave open, break down or otherwise injure such gates or bars he shall forfeit and pay, for every such offense, ten dollars to the person erecting the same or the owner of the land; and if the offense shall be maliciously done he shall be guilty of a misdemeanor: *Provided*, that in case a cartway has been granted by mutual consent of the interested parties and without official sanction the same shall not be closed by any party until opportunity has been given for the establishment of such a cartway as herein provided for; and any person so closing a cartway in violation of this provision shall be guilty of a misdemeanor.

Cartways, how constructed and kept.

Width of road.

Penalty for breaking gates, etc.

SEC. 14. That for the purpose of carrying out the provisions of this act the said superintendent and supervisors are hereby authorized to enter upon any lands near to or adjoining any public roads, to cut and carry away timber, except trees or groves on improved lands planted or left for

Eminent domain to be exercised by certain officers.

ornament or shade; to dig or cause to be dug and carried away any gravel, sand, clay or stone which may be necessary to construct, improve or repair said road, and to enter on any lands adjoining or lying near the road, in order to make such drains or ditches through the same as he may deem necessary for the betterment of the road, doing as little injury to said lands and the timber or improvements thereon as the nature of the case and the public good will permit, and the drains and the ditches so made shall be conducted to the nearest ditch, drain, water-course or waste ground, and shall be kept open by the said superintendent or supervisors, and shall not be obstructed by the owner or occupant of such lands, or any other person or persons, under the penalty of forfeiting a sum of not less than five dollars nor exceeding ten dollars, or imprisonment or work on the public roads of the county for not less than ten nor exceeding twenty days for each and every offense, said penalty to be collected by the said superintendent or supervisor, if in money, and paid over to the county treasurer and applied to the road fund of the county. If the owner of any lands, or the agent or agents of such owner, having in charge lands from which timber, stone, gravel, sand or clay was taken as aforesaid, shall present an account of the same, through the county road superintendent or supervisor, at any regular meeting of the county commissioners, within thirty days after the taking and carrying away of such timber, stone, gravel, sand or clay, it shall be the duty of said commissioners to pay for the same a fair price; and before deciding upon this they may cause to be appointed an impartial jury of three freeholders, one to be selected by the county road superintendent or supervisor, one by the party claiming damages, and the third to be selected by these two, which jury shall report in writing to the board of commissioners their decision for revision or confirmation: *Provided*, that said land owner or his agent shall have the right of appeal as provided for in section thirteen of this act.

Drains and ditches.

Material for road building and improvement.

Price of, how determined.

SEC. 15. That, subject to the approval of the board of county commissioners, the county superintendent or supervisor of roads is hereby given discretionary power, with the aid of a competent engineer, to locate, re-locate, widen or otherwise change any part of any public road where, in his judgment, such location, re-location or change will prove advantageous to public travel. That when any person or persons on whose lands the new road or part of the road is located claims damages therefor, and within sixty days after the change in the road is ordered petitions the board of county commissioners for a jury to assess the damages, the said commissioners, within not less than fifteen nor more than sixty days after completion of said road, shall order said jury of three disinterested freeholders to be summoned by the sheriff or constable or other officer, as provided by law, who shall give said land owners or their local representative forty-eight hours' notice of the time and place when and where said jury will meet to assess damages; and said jury, being duly sworn, in considering the question of damages, shall also take into consideration the benefits to the owner of the land, and if said benefits be considered equal to or greater than the damages

Discretionary powers given to repair or widen roads.

How to proceed.

sustained the jury shall so declare; and it shall report in writing its finding to the board of county commissioners for confirmation or revision: *Provided,* that if said land owner be a non-resident of the county and have no local representative it shall be deemed sufficient service of such notice for said sheriff or constable or officer to forward by United States mail a written notice of the purpose, time and place of such meeting of said jury, to last known post-office address of such land owner, seven days in advance of such meeting; and also to post a notice of the same for seven days at the court-house door of said county: *Provided further,* that the damages awarded, if any, shall be paid out of the road fund of the county or of the township in which the property concerned is located, at the discretion of the board of commissioners.

Proviso.

Proviso.

SEC. 16. That in case the land owner or his local representative shall be dissatisfied with the finding of the juries provided for in sections eleven and twelve of this act, and with the decision of the county commissioners, such dissatisfied party may appeal from the decision of the county commissioners to the superior court of the county; all such appeals being governed by the law regulating appeals from the courts of justices of the peace; and the same shall be heard *de novo;* but the judge may, in his discretion, require said land owner to give bond when the case is taken by appeal to the superior court.

Dissatisfaction by land owner with award of jury, what to be done.

SEC. 17. The county commissioners shall cause to be set up along the highways and principal public roads of the county substantial mile-posts on which are indicated the distance from the county-seat; and at important road-crossings and forks the commissioners shall cause to be erected guide-boards on which are indicated the principal place or places to which these roads lead and the distances to the same. That if any person or persons shall wilfully alter, deface or otherwise injure any such post or guide-board, every person so offending shall, upon conviction thereof before any justice of the peace, be fined any sum not less than five nor more than twenty-five dollars and cost, or imprisoned or sentenced to work on the public roads not less than five nor more than twenty-five days, and the money when collected shall be, by the justice of the peace collecting the same, paid over to the treasurer of the road fund for use in the district where the offense was committed.

Mile-posts.

Guide-boards.

Penalty for defacing, etc.

SEC. 18. That any person or persons who shall wilfully obstruct any public road of the county, or who shall cut, girdle, undermine or in any way weaken and leave standing any tree or trees where they may fall across and obstruct any public road, or who shall interfere with or in any way wilfully or without having taken due precaution, damage any public road, culvert or bridge, or who shall in any way interfere with any officer, laborer or prisoner working on the same, shall be guilty of a misdemeanor and shall be fined or sentenced to work on the public roads, at the discretion of the court. And any officer or employee appointed by virtue of this act, or to whom duties are assigned in this act, who shall fail to make complete returns within the time prescribed therein, or who shall otherwise

Injury to roads, how punished.

Failure of officer to perform duty, misdemeanor.

fail to discharge the duties imposed upon him by this act, and any person or persons or corporations who shall violate any of the provisions of this act, shall in all cases, whether penalties for such failure are or are not prescribed in this act, be guilty of a misdemeanor. All fines imposed and collected in accordance with the provisions of this act shall be turned over by the person collecting the same to the road fund of the county or township interested, at the discretion of the board of county commissioners.

Board of commissioners may reduce number of working days, etc.

SEC. 19. (a) The board of commissioners of any county coming under the provisions of this act, in which the tax for road purposes in the county or any township thereof at the time is not less than fifteen cents on the one hundred dollars worth of property may, at its discretion, at its regular meeting in January, or any regular meeting on or prior to the first Monday in June, reduce the number of days of labor required for road purposes in any such county or township thereof in section four of this act, such reduction not to exceed one day during any year, reducing also in each case the money to be paid in lieu of such labor at the rate of fifty cents for each day: *Provided*, that for each such reduction in the labor requirement the said board of commissioners shall, at its regular meeting in June next following each such reduction, increase the tax levy for road purposes provided for in section one of this act by the amount of two and one-third ($2\frac{1}{3}$) cents on each one hundred dollars worth of property and seven (7) cents on the poll.

Proviso.

Taxes to be regulated by commissioners.

(b) The board of commissioners of any county coming under the provisions of this act, in which the moneys expended for road improvement in the county or any township thereof exceeds an amount equivalent to the tax levy of fifteen cents on the one hundred dollars worth of property may, at the discretion of said board, reduce the money requirement in lieu of the four days' labor on the roads provided for in section four of this act in such county or township thereof to one dollar for each year.

Special tax need not be levied under certain conditions.

(c) In any county coming under the provisions of this act which appropriates annually for road purposes moneys derived from the sale of bonds, or from other taxes, not less in amount than the income from a tax levy of fifteen cents on the one hundred dollars worth of property in such county, the commissioners in said county shall not, while continuing such appropriation, be required to levy the special road tax provided for in section one of this act.

County treasurer to be treasurer of road fund.

SEC. 20. That the county treasurer shall be and he is hereby appointed treasurer of the road fund of the county and of the several townships in the same, and for the faithful keeping and disbursing of said money the bond of such treasurer shall be liable; and for his services in receiving and disbursing such funds he shall receive such a commission as the board of county commissioners may agree upon, not to exceed two per cent. on all moneys disbursed hereunder. He shall pay the accounts against the road fund of the county and of the several townships when itemized statements of the same have been certified to by the county road superintendent or township supervisor and approved by the board of county commissioners. The county treasurer shall keep a separate account of the road fund of the county and of each of the several townships therein, and of his disbursements of the same, and he shall make a written report thereof to the board of county commissioners at their regular meetings on the first Monday in each month; and on the first Monday in July and January of each and every year he shall present to the said board of commissioners a written report, giving a statement of the disbursements from the several road funds during the preceding six months, which reports, or the substance thereof, shall be published by said commissioners in at least one newspaper published at the county-seat for at least one insertion: *Provided*, that the board of county commissioners of the county, for the purpose of prosecuting the road work of the county or any township thereof, are hereby authorized and empowered to borrow money at the legal rate of interest until the taxes are levied and collected in accordance with the provisions contained in section one of this act, and the sum so borrowed shall be paid out of the taxes collected for and applicable to the county road fund, or if borrowed for any township, out of the road fund of the township for which said money is borrowed: *Provided further*, that the said board shall not borrow a sum to exceed two-thirds of the amount of the taxes to be levied and collected for the said county or township road fund.

Duties of treasurer.

Proviso.

Proviso.

SEC. 21. When in any township in any county coming under the provisions of this act a petition is presented to the board of county commissioners, signed by a majority of the qualified voters of said township, asking that in that township an additional special tax be levied for road purposes, or when in any such township, an election being held in accordance with the laws of this State, and the majority of the votes cast at said election being in favor of such special tax, the county commissioners in such county shall, at their next regular June meeting, levy in such township such additional special road tax as they have been requested to levy by said petition or vote, said tax to be levied and collected as provided for other road taxes in section one of this act; and such taxes shall be added to the township road fund of the township in which it is paid, and shall be used only on the roads in that township, under the direction of the board of county commissioners, or under the direction of the three township road commissioners named in said petition or vote, if such be named.

Additional township road tax.

SEC. 22. This act shall apply to the counties of Alamance, Buncombe, Catawba (as specified below), Durham, Forsyth (excepting sections four, five, six and seven), Gaston, Granville (as specified below), Rockingham, Lincoln, New Hanover, Orange, Person (as specified below), Warren, Wilson (Wilson township only).

Applies to certain counties.

SEC. 23. In the counties named below in this section this act may become the road law in each such county, or any township thereof, when adopted as such by the board of county commissioners at any regular meeting, after being requested to do so by petition signed by three hundred (300) freeholders of the county or fifty (50) freeholders of the township; and when so adopted for any such county or township it shall be the road law for such county

May be adopted by other counties.

or township, and all other laws in conflict with this act, as applied to such county or township, shall be then and thereby repealed or suspended during such time as this law may remain in force: Alexander, Granville, Nash, Beaufort, Greene, Northampton, Bertie, Brunswick, Bladen, Caldwell, Chatham, Cleveland, Currituck, Edgecombe, Franklin, Halifax, Hyde, Johnston, Jones, Lenoir, McDowell, Moore, Pamlico, Pasquotank, Perquimans, Rowan, Richmond, Polk, Stanly, Swain, Vance, Washington, Yadkin, Wilson, Jackson, Tyrrell, Robeson and Iredell.

Provisions as applied to Alamance county.

SEC. 24. As applied to Alamance county, this act shall require only three day's labor on public roads during any one year, or the sum of one dollar and twenty-five cents, to be paid in lieu of the same. This law shall apply to Catawba county or any township thereof when adopted by the board of county commissioners for said county or such township; and the board of commissioners immediately upon the adoption of this law are hereby authorized and empowered to elect the necessary officers and proceed at once with the road work herein provided for. As applied to Catawba and Person counties, this act shall be in force only when it is not in conflict with an act for working the public roads of these counties passed by the General Assembly of nineteen hundred and one. As applied to Warren county, the proviso at the end of section twenty shall not be in force; nor shall the amendment made in this act be in force when in conflict with the special road law for River and Judkins townships in said county, passed by the General Assembly of nineteen hundred and one (1901).

Catawba county.

Catawba and Person counties.

Warren county.

Granville county.

SEC. 25. As applied to Granville county, this law as herein amended shall be in force, except wherein it may be in conflict with the first ten sections of "An act to authorize the commissioners of Granville county to issue bonds to macadamize and improve the public roads thereof," passed by the General Assembly of nineteen hundred and one (1901); and section eleven of this act just named is hereby amended by inserting after "1899" the words "As amended by the General Assembly of nineteen hundred and one."

Chapel Hill township.

SEC. 26. That in this act, as applied to Chapel Hill township in Orange county, G. E. Donnell, W. F. Cole and J. A. Holmes of said township shall be and the same are hereby constituted a special road commission for said township, which road commission, in carrying out the provisions of this act as applied to said township, is hereby vested with all the duties, rights and powers (except that of levying taxes) otherwise in this act conferred upon the county commissioners. The county commissioners, under section one of this act, shall levy such and only such road tax for Chapel Hill township, within the limits prescribed in section one of this act, as may be recommended by said board of road commissioners, and all moneys arising therefrom shall be kept separate by the county treasurer and shall be expended in Chapel Hill township; vacancies on said board of road commissioners shall be filled by the board of county commissioners; and its members shall be paid out of the township road fund, not exceeding one dollar per day each, while actually engaged in the necessary work of the commission, for not more than three days during any one month. Such moneys as may be paid in lieu of the labor in said township may be collected by the supervisor of roads elected by said road commission and deposited by him for road purposes in such manner, and with such person, and expended as may be designed by the said road commission of the township.

Act does not apply to.

SEC. 27. This act shall not apply to the following counties: Anson, Ashe, Alleghany, Burke, Cabarrus, Camden, Chowan, Cherokee, Craven, Carteret, Clay, Columbus, Cumberland, Dare, Davie, Duplin, Caswell, Graham, Gates, Guilford, Henderson, Harnett, Macon, Montgomery, Martin, Madison, Mitchell, Onslow, Pitt, Person, Randolph, Rutherford, Sampson, Surry, Transylvania, Wayne, Wilkes, Wake, Union, Watauga, Yancey, Scotland, Hertford, Davidson, Stokes and Haywood: *Provided*, that in any county or township not coming under the provisions of this act, but otherwise providing funds for road improvement, the commissioners of such county may at any regular meeting, at their discretion, adopt any of the sections (except section one, levying a tax) of this act that in their judgment may be specially adapted to the needs of their county and incorporate the same in the road law of the said county.

Proviso.

Conflicting laws repealed.

SEC. 28. That all laws and parts of laws in conflict with this act are hereby repealed.

SEC. 29. That this act shall be in force from and after its ratification.

In the General Assembly read three times and ratified March 14, A. D. 1901.

FORM OF PETITION REQUESTING THE ADOPTION OF THE GENERAL ROAD LAW OF 1899 AS AMENDED IN 1901.

The following may serve as a suggestion in the way of the general form of petition to be presented to the county commissioners asking them to adopt this road law as provided for under section 23 of the same:

We, the undersigned freeholders of______ ______ ______county,* respectfully petition the honorable Board of Commissioners of this county at their next regular meeting to adopt the general road law entitled "An act to provide for the better working of the public roads and highways of the State," enacted by the General Assembly of 1899, as the road law for this county. †

---

*Or township of the county of__________in case it is desired to adopt the law for some special township and not for the county as a whole.

†Or township, as the case may be.

THE WIDE TIRE LEGISLATION.

ADVANTAGES OF WIDE TIRES.

The benefits resulting from the use of wide tires on wagons and other vehicles are twofold:

1. By the rolling and packing effect of these wide tires the road surface is made smooth and even, instead of being cut into deep ruts, as is the case in the use of narrow tires. Thus a wagon with tires six inches wide will pack twelve inches of road surface every time it passes along; a wagon with tires $1\frac{1}{2}$ inches wide would pack only three inches of road surface; and if we adopt a practice similar to that followed in Europe of having the front and rear axels of different lengths, the wagon with six-inch tires would roll and pack twenty-four inches of road surface. Thus the wide tire not only prevents a road surface from being cut to pieces but it also smooths the surface so as to make it much better for traveling. Even in the case of macadam roads, where the surface is more or less hard and firm, the narrow tire tends to crush the rock and wear the surface into ruts; whereas the wide tire tends to pack and make smooth this surface.

2. As a rule where the wide tires are used heavier loads can be pulled or the same loads pulled more easily, even taking the road surfaces as they exist, than with narrow tired wagons; and when it is remembered that the wide tire makes a road surface more smooth and even it will be more readily understood that still larger loads can be pulled in any wagon on roads which have thus been packed by wide tires than in the same wagon on another road which has been cut up through the use of narrow tires.

The use of these wide tires on all draft vehicles and even on spring vehicles in European countries is almost universal. It has there been a long recognized fact that the use of such tires is not only better for the team but also better for the roads. This practice of using wide tires is now being introduced in many portions of our own country, and on roads of all descriptions—sandy roads, clay roads and macadam roads. The practice is proving beneficial.

The following statement gives some of the more striking results obtained from an elaborate series of experiments comparing the loads that can be hauled on wide and narrow tired wagons, by the Missouri Agricultural Experiment Station:

On Macadam roads an average of 26 per cent. in favor of wide tires.
On gravel roads 26 to 45 per cent. in favor of wide tires.
On ordinary dirt roads 22 to 71 per cent. in favor of wide tires.
On ordinary meadow lands 22 to 84 per cent. in favor of wide tires.
On pasture lands 26 to 89 per cent. in favor of wide tires.
On stubble lands 34 to 72 per cent. in favor of wide tires.
On plowed ground 33 to 44 per cent. in favor of wide tires.
On clay road with deep mud and deep ruts 10 to 49 per cent. in favor of narrow tires. But with the general introduction of wide tires this condition of things (deep mud and deep ruts) would not exist.

The results of these tests, and indeed the whole question of the use of wide tires, is discussed more fully in a later report, copies of which can be had by application at the office of the Highway Commission.

THE TEXT OF THE WIDE TIRE LAW

is given on the following page.

AN ACT TO PROVIDE FOR THE IMPROVEMENT AND PROTECTION OF THE PUBLIC ROADS OF THE STATE, THROUGH THE USE OF WIDE TIRES ON WAGONS AND OTHER DRAFT VEHICLES.

Whereas, the use of wide-tired vehicles on the public roads of the State, as shown by experience, will both benefit and protect these roads by packing and smoothing the surface of the same;

The General Assembly of North Carolina do enact:

Section 1. That every person, firm or corporation in the State who, during the year ending December thirty-first, 1899, and each succeeding year thereafter owns and uses on the public roads of the State any wagon or other draft vehicle with tires as wide as the standard wide tire wheels described in section 2 of this act, shall on the presentation of proof thereof, satisfactory to the commissioners of any county in which said wide tire vehicles are used, be paid by the county treasurer of such county, out of the road fund of the county or township in which the same is used, each and every year, for a period of five years, a sum equal to one-half his or her road tax: *Provided*, that in no case shall the amount so paid for any year be greater than two dollars on one such vehicle, nor in any case shall the total amount paid to any one person, firm or corporation exceed the sum of five dollars during any one year; and *Provided further*, that in case any such person pays no road tax, he shall during each and every year, for a period of five years, be exempt from one-half of the labor which under the law he may otherwise be required to expend on the public roads of the county or township in which he resides.

Sec. 2. For the purposes of this act, the standard for wide tire wagons and other draft vehicles shall be as follows: For a *one-horse vehicle* (with skeins 2½ by 8 inches or under, or spindles 1⅜ by 7 inches or under), two and one-half (2½) inch tires; for *two-horse vehicles* (with skeins larger than 2½ by eight inches, not over 3 by 9 inches, or with spindles more than 1⅜ by 7 inches, and not over 1¾ by 10 inches) four inch tires; and for all vehicles with skeins and spindles larger than the above, six-inch tires.

Sec. 3. This act shall only apply to the following counties: Alamance, Edgecombe, Lincoln, Mecklenburg, Moore, Orange (for Chapel Hill Township only), New Hanover, Rowan, Wilson, Durham and Granville.

Sec. 4. This act shall be in force from and after its ratification.

Ratified this the 7th day of March, 1899.

It is advisable to use six-inch tires even on two-horse wagons.

An Act to Improve and Preserve the Public Roads of Charlotte Township in Mecklenburg County.

The General Assembly of North Carolina do enact:

License tax on persons owning and operating vehicles in Charlotte township to be applied to road improvement.

Schedule of taxes.

One, two, three and four-horse wagons defined.

No person to use wagons on roads of said township without first obtaining license.

Proviso.

Further proviso.

Width of tires defined.

SECTION 1. That in addition to the property tax now levied for road purposes in Charlotte township, Mecklenburg county, under existing laws, a license tax shall be imposed and collected annually for road purposes from every resident of Charlotte township owning and operating any wagon upon any of the public macadamized roads or streets therein, as follows: On each one-horse wagon, a tax of $1.50; on each two-horse wagon, a tax of $3.00; on each three-horse wagon, a tax of $4.00; on each four-horse wagon, a tax of $5.00; provided that for the purposes of this act all wagons with skeins 2½x7½ inches, or spindles 1¼x7 inches or under, shall be known as one-horse wagons; all wagons with skeins over 2½x7½ inches, or spindles 1¼x7 inches, and not over 3x9 inches for skeins, or 1⅝x9 inches for spindles, shall be known as two-horse wagons; all wagons with skeins over 3x9 inches, or spindles 1⅝x9 inches, and not over 3½x10½ inches for skeins, or 1¾x10 inches, shall be known as four-horse wagons and taxed accordingly, and no person shall use any of such wagons upon any of the public macadamized roads in said township without first having obtained a license thereto, in the manner hereinafter prescribed: *Provided, however*, that this act shall not apply to what are known as narrow tired wagons, now in use, so long as the tires now on said wagons shall remain thereon: *Provided further*, that this act shall not apply to what are known as standard broad tired wagons, which wagons may be used upon any of the public roads of said township without a license for the privilege of so doing. For the purposes of this act the standard broad tires for a one-horse wagon shall be two inches wide; for a two-horse wagon three inches wide; for a three-horse wagon four inches wide; for a four-horse wagon five inches wide.

Tax, how imposed and collected.

Persons desiring to use wagon on roads to apply to supervisor of public roads for license.

Duty of supervisor to issue license.

License or tax tag to be securely fastened to wagon.

Supervisor to keep record of licenses, etc.

SEC. 2 That the tax provided for under section one of this act shall be imposed and collected from the person or persons owning or using such wagon or wagons for the privilege of operating the same upon the public macadamized roads in said township; and it shall be the duty of every such person desiring to use any wagon not hereby exempt from a license tax to first apply to the supervisor of public roads for said township for a license in accordance with the provisions of this act, whereupon it shall be the duty of said supervisor, upon the receipt of the amount of the required tax, to issue to such person a metal tag with the number, the words "tax paid," and the year in which it is issued, all stamped thereon. Said tax tag, when so issued, shall be securely fastened or attached to said wagon in some conspicuous place, and it shall be kept so attached during the current year for which said tax is paid. It shall also be the duty o said supervisor to keep a book, in which he shall enter the name of each person applying for and obtaining a license under this act, with the dat when issued, the amount paid by each, and the number of the tax tag so issued; and said supervisor shall receive out of the moneys so collected a fee of twenty-five cents for each tag issued: *Provided, however*, that any person losing any tax tag which shall have been lawfully issued to him, shall upon satisfactory proof of such loss, be entitled to receive from said supervisor a duplicate of the same, upon paying to him the sum of twenty-five cents, which he shall receive as a fee for issuing such tag.

Supervisor's fee for issuing license.
Proviso.

SEC. 3. That the taxes collected under the provisions of this act shall be applied to the road fund of Charlotte township, provided that all taxes on wagons chiefly used and operated within the corporate limits of the city of Charlotte shall be paid to the tax-collector of said city, whose duty it shall be to issue tags in accordance with the provisions of section two of this act; and the moneys so collected shall be applied to street purposes.

Taxes to be applied to road fund of Charlotte township.
Proviso as to wagons operated in city of Charlotte.

SEC. 4. Any person violating this act by failing to pay the tax hereby imposed, shall be liable to a penalty of double the amount of said tax, to be sued for in a civil action in the name of the supervisor of public roads for Charlotte township; one-half of the recovery to go to the road fund of said township and the other half to the informer: *Provided*, that in case any person shall violate this act by failing to pay any tax required to be paid to the tax-collector of the city of Charlotte, the civil action in this section provided for shall be prosecuted in the name of such tax-collector instead of the supervisor of public roads for said township.

Penalty for failure to pay license tax.
How collected.
Proviso.

SEC. 5. Any person violating any of the provisions of this act shall be guilty of a misdemeanor, and shall, upon conviction, be subject to a fine of not more than fifty dollars, or imprisoned for not longer than thirty days.

Violation of act a misdemeanor.
Penalty.

SEC. 6. All laws in conflict with the provisions of this act are hereby repealed.

Conflicting laws repealed.

SEC. 7. This act shall be in force from and after the first day of August, 1901.

When act effective.

In the General Assembly read three times and ratified this the fourth day of March, A. D. 1901.

Ratification.

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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper, No. 6.

THE MINING INDUSTRY

IN

NORTH CAROLINA DURING 1901

BY

JOSEPH HYDE PRATT

MINERALOGIST

RALEIGH
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LETTER OF TRANSMITTAL.

Raleigh, N. C., **May 1st, 1902.**

To His Excellency, Hon. C. B. Aycock,
Governor of North Carolina.

Sir:—I have the honor to submit for publication, as the sixth of a series of economic papers, a report on the *mining industry* in North Carolina for 1901. Its publication is intended to meet inquiries that are constantly being received at this office for information concerning the condition of the mining industry and the different minerals that are being mined in the State. It takes up more in detail than the report of last year, descriptions of the occurrences of economic minerals in the State, and calls attention to those that are worthy of further investigation and that give promise of developing into remunerative properties.

Yours obediently,

J. A. Holmes,
State Geologist.

MINING INDUSTRY IN NORTH CAROLINA DURING 1901.

INTRODUCTION.

The first year of the new century (1901) that has just closed has seen a decided gain in the mining industry of North Carolina. There has been an increased production of minerals and a progressive substantial development of mineral properties. The most notable features of the mining industry are the very extensive developments that are being carried on in the Person county and Ashe county copper belts; the increased demand for monazite; and the large increase in the production of kaolin and talc. Among the iron mines there has been a slight increase in the development of properties, but the production has been confined to one mine. In the gold fields there has been a steady advance in the manner in which new properties have been opened up, and old ones put into shape to become producers.

There are many natural advantages that are favorable to mining operations in North Carolina. The mining fields are all within easy distance of the large business centers; thus leaving New York at 4:30 P. M., North Carolina is reached early the next morning and by the same night nearly any mining camp in the State can be reached. Labor is cheap, although really skilled labor commands about the same price here as in other southeastern States, but is much less than corresponding labor in western mining camps. Climatic conditions permit of nearly continuous mining throughout the year. Most of the mines are in proximity to railroads and also centers of mining supplies, as Charlotte and Salisbury; and to timber for lumber and cordwood which can be obtained at a low cost. Another important advantage is the abundance of water-power that is available at many of the mining localities, which would make practicable the installation of electric power plants. While there have been some failures in mining during 1901, there has been less speculative mining than for many years; and the mining and prospecting that is being carried on is along legitimate lines. That this is reacting favorably is apparent from the renewed interest that capitalists are now taking in North Carolina mining propositions, and the large amount of money that is being systematically spent in the development of mines and mineral properties.

Often, when occasions arise that increase the demand for a certain mineral; or trade conditions change so that new sources of supply are imperative; or new industries spring up that call for certain minerals for their manufacture, these minerals are found in large quantities where, in many cases, they were formerly supposed to be rare. North Carolina has furnished many of these, and when there is a demand for a new commercial mineral it is one of the first States that is looked to to furnish the supply. Every year minerals new to the State are being added to the list and frequently a new mineral species is discovered, thus constantly increasing the variety of minerals to be found within the Commonwealth.

It may be of some advantage as well as of interest to give here a list of the minerals that have been found in the State, and to indicate those that have a commercial value and of these, those that have been found in quantity in North Carolina. There are now 205 minerals that have been identified in North Carolina, some of which are new species that were first identified in this State, and these are indicated in the list below by the letter *a*.

LIST OF MINERALS FOUND IN NORTH CAROLINA.

1. Actinolite (an Amphibole).
2. _Albite*_ (a Feldspar).
3. Allanite.
4. _Almandite.*_
5. Altaite.
6. Alunogen.
   Amazon Stone (Var. Microcline).
   Amphibole (Group name).
7. Anatase.
8. _Andradite.*_
9. Andesine (a Feldspar).
10. _Anglesite._
11. Anorthite (a Feldspar).
12. Anthophyllite.
13. _Anthracite Coal._
14. _Antimony._
15. _Apatite._
16. _Arsenopyrite._
17. Arfedsonite.
18. _Argentite._
19. Arragonite.
20. _Asbestos*_ (an Amphibole).

21. Auerlite.[a]
22. Augite (a Pyroxene).
23. Autunite.
24. _Azurite._
25. _Barite._*
26. Barnhardtite.[a]
27. _Beryl._*
28. Biotite.
29. Bismite.
30. Bismutite.
31. Bismuthinite.
32. _Bituminus Coal._*
33. _Bornite._*
34. Braunite.
35. Breunnerite.
36. Bronzite.
37. Brookite.
38. _Calamine._
39. _Calcite._
40. _Cassiterite._
41. _Cerargyrite._
42. Cerolite.
43. _Cerussite._
44. Chabasite.
45. _Chalcanthite._
46. _Chalcedony._*
47. _Chalcocite._*
48. _Chalcopyrite._*
Chlorite (Group name).
49. Chloritoid.
50. _Chromite._*
51. _Chrysocolla._
52. _Chrysolite_ (Olivine).
53. _Chrysoprase._
_Chrysotile_* (Var. of Serpentine).
54. Columbite.
55. _Copper._
56. _Corundum._*
57. Covellite.
58. Crocidolite.
59. Crocoite.
60. Culsageeite.[a]
61. _Cuprite._
62. Cuprosheelite.
63. Cyanite.
64. Cyrtolite.
Damourite (Var. of Muscovite).
65. Deweylite.
66. _Diamond._
67. Diaspore.
68. Diopside (a Pyroxene).
69. _Dolomite._
70. _Dudleyite._[a]
71. Dufrenite.
72. Edenite (an Amphibole).
73. Enstatite.
74. Epidote.
Feldspar.* (Group name).
75. Fergusonite.
76. Fibrolite.
77. _Fluorite._
Fuchsite (Var. of Muscovite).
78. Gahnite.
79. _Galena._
Garnet* (Group name).
80. _Garnierite._
81. _Genthite._
82. Glauconite.
83. _Gold._*
84. Goslarite.
85. _Gothite._
86. _Graphite._*
87. _Gummite._*
88. _Gypsum._
89. _Halite._
90. Halloysite.
91. Hatchettolite.[a]
92. Hausmanite.
93. _Hematite._*
Hiddenite[a]* (Var. of Spodumene).
94. Hisingerite.
95. Hornblende (an Amphibole).
Hyalite (Var. of Opal).
96. Hydrofergusonite.
97. Hypertshene.
98. _Ilmenite._
99. Iron (meteoric).
Itacolumyte (Var. of Quartz).
100. Jefferisite.
Kammererite (Var. Penninite).
101. _Kaolinite_* (Kaolin).
102. Kerrite.[a]

103. Labradorite (a Feldspar).
104. Lazulite.
105. Leucopyrite.
106. _Lignite_ (Brown coal).
107. _Limonite._*
108. Linarite.
109. Lucasite.[a]
110. Maconite.[a]
111. _Magnesite._
112. _Magnetite._*
113. _Malachite._
114. Marcasite.
115. Margarite.
116. Marmolite.
117. Martite.
118. Melaconite.
119. Melanterite.
120. _Microcline_* (a Feldspar).
121. Mitchellite.[a]
122. _Molybdenite._
123. Molybdite.
124. _Monazite._*
125. Montanite.
126. Montmorrillonite.
127. _Muscovite._*
128. Naryagite.
129. _Niter_
130. Octehedrite.
131. _Oligoclase_* (a Feldspar).
132. Olivenite.
133. _Orthoclase_* (a Feldspar).
134. _Opal._
135. Paragonite.
Pargasite (Var. of Hornblende).
136. Penninite.
137. Pharmacosiderite.
138. _Phlogopite._
139. Phosphuranylite.[a]
Picotite (Var. of Spinel).
140. Picrolite.
Pinite (Var. of Muscovite).
141. Pleonaste.
142. _Polycrase._
143. Prochlorite.
144. _Psilomelane._
145. Pseudomalachite.
146. _Pyrite._*
147. Pyrochlore.
148. _Pyrolusite._*
149. Pyromorphite.
150. _Pyrope._*
151. _Pyrophyllite._*
Pyroxene (Group name).
152. _Pyrrhotite._
153. _Quartz._*
154. Rhodochrosite.
155. _Rhodolite._*[a]
156. Rogersite.[a]
Ruby Spinel (Var. of Spinel).
157. Rutherfordite.[a]
158. _Rutile._
159. _Samarskite._*
160. Saponite.
161. _Sheelite._
162. Schreibersite.
163. Scorodite.
164. Senarmontite (or Valentinite).
165. _Serpentine._*
166. _Siderite._*
167. _Silver._*
168. Sillimanite.
169. Smaragdite (an Amphibole).
Soapstone* (Var. of Talc).
170. _Sphalerite._
171. _Sperrylite._
172. Spessartite.
173. _Spinel._
174. _Spodumene._
175. Staurolite.
Steatite (Var. of Talc).
176. _Stibnite._
177. Stilbite.
178. Stolzite.
179. _Succinite_ (amber).
180. _Sulphur._
181. _Talc._*
182. Tantalite.
183. _Tenorite._
184. Tetrahedrite.
185. Tetradymite.
186. Thorite.
Thulite (Var. of Zoisite).

187. Titanite (Sphene).
188. *Topaz.*
189. Torbernite.
190. *Tourmaline.*
191. Tremolite (an Amphibole).
192. Troilite.
193. *Uraninite.**
194. Uranophane (Uranotil).
195. Vermiculite.
196. Vivianite.
197. Wad.
198. Wavellite.
199. Wellsite.[a]
200. Willcoxite.[a]
201. *Wolframite.*
202. Xanthitane.
203. Xenotime.
204. *Zircon.**
205. Zoisite.

Of these 205 minerals, those in italics are of commercial value and of these, those marked with an asterisk have been found in sufficient quantity in North Carolina to warrant either mining or further developing them. It is not at all improbable but that in the course of time some of these other minerals will have a commercial value, and that large deposits will be found of those which are now known to have a commercial value but which have thus far been found but sparingly in North Carolina.

The close of the first year of the new century shows a most promising increase in the mineral production of the State, the total production being $1,764,233.94 as compared with $1,604,078 in 1900. All indications are that at the end of 1902 there will be a large increase in the mineral production over that of 1901. Many mining enterprises are being conducted on a larger scale than before and by the combining of some of the smaller mines under one management, they could be worked to better advantage. The condition of the mining industry in North Carolina at the beginning of 1902 and some idea of its outlook for the future are given in the following pages, which take up in detail the mining operations of the various minerals.

GOLD.*

The North Carolina gold deposits have been worked more or less continuously since 1799, which is the first authentic account of gold having been found in the State. Since that time there has been over $22,000,000 worth of gold mined. Although this is a favorable record, yet at the present time the gold mining industry is not in a very active condition. The causes for this decline are the exhaustion in many mines of the free milling ores, and of the richer placer deposits; the methods employed in mining; and a lack of knowledge of the treatment of the sulphurets.

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*See also Bulletin 10, N. C. Geol. Survey, On Gold Deposits of N. C.

The area in which the gold deposits are known to occur is a broad one, embracing from 8,000 to 10,000 square miles of the middle and western counties. There are three types of occurrences of these ores, as follows: In quartz fissure veins, carrying either free gold, or gold-bearing sulphurets; impregnations of free gold and finely divided sulphurets in the country schists and slates; and the placer deposits.

There are in the neighborhood of 400 localities in the State that have have been mined for gold; but at the present time there are not over 15 mines that are being worked, principally in Cabarrus, Mecklenburg, Davidson, Stanly, Montgomery and Rowan counties. There have been a number of new gold properties opened up and developed during 1901, but the greater part of the work has been confined to old mines and properties, some of which have been quite extensively operated. While there has not been as much actual mining, as was expected, yet there has been a great deal of work done, the greater part of which has been systematic and valuable.

Improved methods and machinery are making it more possible from year to year to use ores that were formerly supposed to be of little value or of a too refractory nature to be economically worked. Then again, there has been too much of a tendency to operate the mines on too small a basis, and it will be found that if a number of these gold deposits are operated under one management, they will make a profitable investment, while they are unprofitable when worked separately. The establishment of a custom smelter at Charlotte will be a strong incentive to more active mining in Mecklenburg and neighboring counties. This smelter is being erected by the United States Smelting-Refining Company of New York. They will obtain a portion of their supply of ore from their own mines, but expect, however, to draw the larger part of the ore from other mines in the vicinity. This should be the means of the re-opening of many of the smaller mines and properties which are not capable of supporting a smelter of their own.

TREATMENT OF SULPHURET ORES.

In the treatment of the Carolina sulphuret ores, consideration must be taken of the rocks in which they occur. A large proportion of these ores occur in a rock consisting essentially of argillaceous schists and slates that are interlaminated with thin layers or lenses of quartz. Some of these rocks were igneous in origin, but have been altered to their present condition. There are bands of these rocks that are impregnated with free gold and finely divided gold-bearing sulphurets. The metallic contents are usually heavier along the cleavage planes of the schists and where the free gold exists it is often in a very finely divided and flaky condition. On account of the fineness of the gold and the slimy condition of the crushed ore, there is considerable difficulty encountered in saving the gold. A portion of the gold can be saved by amalgamation, but the tailings from the plates must be treated either by the chlorination or cyanide process. When the ore is wholly or partially in the form of sulphides it must be roasted in order to free the gold before it can be treated by either of these processes.

In regard to the cost of roasting these sulphide ores of the Southern Appalachian region, the only figures available are those of Mr. Thies, superintendent of the Haile gold mine, Lancaster county, South Carolina,* and "it is evident from a perusal of his figures that the cost per ton can be considerably reduced by the use of McDougall or Herreshoff roasters. In Montana, where labor is higher and fuel is at least double what it is in the South, the cost for this character of work would not exceed 60c. per ton. Using the improved machinery now in use throughout the West and having the advantage of the low prices prevailing in the South, the cost should not exceed 50c. per ton.

"In reports by many eminent mining engineers, made during the past 20 years, the gold deposits of the South have been quite conclusively shown to contain an abundance of low-grade ore. The question has not been the amount of ore, but as to the economy of treatment. Within a radius of 20 miles of Salisbury, North Carolina, there are at least two dozen mines of unquestioned merit, not one of which is in active operation to-day. It is quite evident then that the field is a large one, and a promising one for the introduction of a cheap process. The success of the chlorination process of Mr. Thies gives assurance that the cyanide process, when adapted to these ores, will be equally successful, and as it is relatively cheaper there is no question as to a choice between the two methods; the cost of dead roasting will be the same in both cases. The cyanide plant, however, will, it is believed, cost less to build, less to operate, and the cost for chemicals will be less. If the ores contain oxides or carbonates of copper, chlorination may be necessary. Where the copper occurs as a sulphide, there is no reason why the cyanide process cannot be used. The successful plants that have treated the ores by chlorination recovered on a $4 ore, $1.30 on the plates, $1.80 in concentrates, and the tailings carry 90c. The concentrates treated by chlorination yielded an extraction of 94 per cent., so that the total extraction of the assay value of the ore is only 75 per cent.

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*Eng. and Min. Jour., Oct., 1901.

"In order to treat such ores economically a plant should have a capacity of not less than 50 tons per day. A roaster to successfully handle that amount of ore per day will cost not less than $10,000 when erected and ready for operation; the necessary cyanide vats, agitators, etc., will cost in the neighborhood of $1,000 or $2,000 more, and a working fund of $10,000 should be allowed for mine development."*

Judging from the treatment of the slimy ores in various mills in Montana, the cost of mining and milling these ores should not exceed $2 per ton; of course, tailings could be treated much cheaper. A prominent cyanide man, after visiting the Howie mine and other deposits in North Carolina and Georgia, wrote,† "that he knows of no more promising field in the United States for the extension of the cyanide process; that it possesses so many decided advantages over other sections that those who now take advantage of the situation and the low valuation at which the properties are held are certain to be richly rewarded. With the selection of a property worthy of a good plant and the exercise of the same business prudence and sagacity in operating it that would be needed in other lines of industry, one is certain to be remunerated to an extent far beyond what one could hope for from any other merchantile investment."

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*W. H. Weed, Eng. and Min. Jour., Oct. 19, 1901.

†Eng. and Min. Jour., Oct. 19, 1901.

LOCALITIES.

There has been but little work done in 1901 in what is called the Eastern Carolina gold belt, which covers an area of about 300 square miles in Warren, Halifax, Franklin and Nash counties, and extends in a northwesterly direction from the Thomas mine, 1½ miles northeast of Ransom's Bridge, to and across the Tar river. Among the mines of this belt are the Thomas, Kearney, Taylor, Mann, Davis, Nick-Arrington, Mann-Arrington and Portis, the two latter being the most important. The principal work was done on the properties in the vicinity of the Portis mine, Nash county, where there has been some sluicing of the placer deposits and also on the Davis property.

The principal mining district of the Carolina belt is in the vicinity of Gold Hill, Rowan county. It is situated about 14 miles southeast of Salisbury in the southeast corner of Rowan county and extending into Cabarrus county on the south, and Stanly county on the east. The country rocks are chloritic and argillaceous schists, striking N. 25° to 30° E. and dipping 75° to 85° N. W. A diabase dike cuts the schists near the village of Gold Hill. The ore bodies consist of certain portions or bands in the schists that are impregnated with auriferous pyrite and of imperfectly conformable lenticular veins and stringers of quartz. There are six well defined approximately parallel veins in this district, known as the Randolph, Barnhardt, Honeycut, Standard, Trautman and McMakin. The principal work being done in this district for gold is by the Whitney Reduction Company, who are operating at and near the old McMakin mine. They have developed their mine by three shafts, the deepest one being about 600 feet, with cross-cuts between them. A well formed ore body has been blocked out that assays very favorably. In connection with their mining this company are developing the water-power at the Narrows of the Yadkin river and will erect their stamp-mill at this point. The Gold Hill Copper

Company expect to begin work at the Barnhardt mine during the coming year. The Union Copper Mining Company are mining principally for copper, but obtain more or less gold and silver as by-products. See page 20.

In Montgomery county one of the most noted mines is the Russell, which is about 3 miles northeast from Eldorado, and but a short distance from the Randolph county line. The country rocks are argillaceous slates, both of soft and silicified types. In part at least these slates are sedimentary and have a variable strike and dip. The ore beds consist of parallel belts in the slates impregnated with iron sulphurets (pyrite), and free gold together with some quartz stringers. The principal work at this mine consists of a big cut about 300 feet long by 150 feet wide and 60 feet deep. On the eastern edge of this cut is a shaft 150 feet deep, from the bottom of which the ore has been stoped upward. This mine is one of considerable promise and as far as can be determined contains low grade ore in quantity.

Some of the other principal mines and properties in this county are the San Christian, Appalachian (or Cogging), Morris Mountain, Riggon, Hill, Steel, Saunders, Marratock, Beavers Dam and Buck Mountain.

The Reed mine in Cabarrus county is about 11 miles southeast of Concord and is of interest as being the site of the first discovery of gold in North Carolina. In 1799 a 17-pound nugget was found and in 1803 one weighing 28 pounds. The placer deposits of the Reed mine have been very vigorously worked in former years and a considerable quantity of gold has been found. There are a number of other promising gold properties in this county, among which are the Nugget, Rock River, Buffalo, Phœnix, Furness, Tucker and Pioneer Mills mines, some of which have been more or less worked and developed during the past year.

Mecklenburg has been one of the most important and active counties in gold mining of any in the State. The mines are distributed over almost the entire county, with Charlotte as a center. The more important mines are the Davidson Hill (one mile west of Charlotte), Saint Catherine, Rudisil and Clark (2½ miles west of Charlotte), Palmer, Howe and Parks (1 mile northeast of Charlotte), Brawley

(4 miles west of Charlotte), Arlington (6 miles west of Charlotte), Capps, McGinn and Alexander (8 miles northwest of Charlotte), Dunn (7 miles northwest of Charlotte), Ferris and Ray (8 miles southeast of Charlotte), and Surface Hill (10 miles east of Charlotte).

The Rudisil mine, which is 1 mile south of Charlotte, is perhaps the best known. In the upper part of the mine the rock is a silicified, chloritic and argillaceous slate. At a depth of 200 feet this gives place to a crystalline eruptive rock. The ore bed consists of two parallel veins, close together and separated by a slate which varies in thickness from 2 to 6 feet. The maximum depth to which the mine has been worked is 300 feet. The mine carries very rich but highly sulphureted ores, and thus far but little attempt has been made at concentration or treatment of these sulphurets. Many of these mines will become producers when the custom smelter is able to handle their ores.

In Gaston county the principal mines are the Oliver and Farrar, which are about 12 miles northwest of Charlotte, the former of which is reported to have been worked by one of the early German settlers before the Revolutionary War; the Duffie, McLean, Long Creek and King's Mountain (or Catawba).

The King's Mountain (or Catawba) mine is situated about 1½ miles south of King's Mountain, a station on the Southern Railway, in the southwest corner of the county. The country rock is mica schist intercollated with lenticular layers of siliceous magnesian limestone. The ore beds are large lenticular chimneys or shoots of this limestone containing auriferous quartz and sulphurets. Five of these chimneys or lenses have been opened in this mine. The length of these lenses reach about 100 feet and in thickness they are about 20 feet, being separated from each other by the black graphitic slate. The mine has beeen worked to a depth of 320 feet.

The principal mining that has been done in the South Mountain gold region has been the hydraulicing and sluicing of the extensive placer deposits which are found in Burke, McDowell and Rutherford counties, and it has only been within the last few years that any attempt has been made to work the quartz veins. Many of the gold-bearing quartz veins are too narrow to justify any deep mining, but there are some that have been found on a much larger scale that give promise of making profitable mines. The principal work now being done on these veins is a section 6 and 12 miles north of Morganton, where two types of gold deposits have been encountered, one in which the gold occurs in the quartz veins and the other where it occurs in bands of the country rock, either in the form of free gold or finely divided sulphurets. This district is perhaps attracting as much attention as any other at the present time and has within the past two years furnished some splendid gold ore during the development work. The principal mines in this South Mountain district are the Miller, Scott Hill, Pack's Hill, and Baker mines in Caldwell county; the Mill's property, Hancock, Hercules and Martha mines in Burke county; Cain Creek, Brackettown, Huntsville and Vein in McDowell county; and the Golden Valley in Rutherford county.

There has been a little gold mining in Cleveland county and in the vicinity of Columbus, Polk county.

West of the Blue Ridge there has been but little mining carried on for gold, and it has been principally the sluicing of the gravels in Cherokee county.

The total production of gold in North Carolina for 1901 was $60,410.71 (coining value) as compared with $44,653 in 1900. This is an increase of $15,757.71, which indicates the advance that is being made in gold mining in the State. In the table below are given the production of gold and silver by years from 1882 to 1901.

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1901.*

YEAR.	GOLD.	SILVER.
1882	$ 190,000	$ 25,000
1883	167,000	3,000
1884	157,000	3,500
1885	152,000	3,000
1886	175,000	3,000
1887	225,000	5,000
1888	136,000	3,500
1889	145,000	3,878
1890	118,500	7,757
1891	95,000	6,465
1892	78,560	12,671
1893	53,600	17,325
1894	46,594	455
1895	54,200	520
1896	44,300	646
1897	34,600	388
1898	84,000	905
1899	34,500	388
1900	44,653	15,986
1901	60,410	34,023

While gold mining is at the present time but a small industry in North Carolina, when its production is considered, it is of considerable magnitude when the working capital invested in gold mines and properties is taken into consideration. The work that is now being carried on will result in the mines again becoming producers of gold in larger quantity than for the past twenty years.

SILVER.

There are mines in North Carolina that have been operated during 1901 exclusively for silver; but more or less silver is obtained in nearly all of the gold and copper mines, especially the latter. The copper mines at Gold Hill and in the Blue Wing district have produced most of the silver.

The principal silver mines are the Silver Hill, located 7 miles southeast of Lexington, Davidson county, and the Silver Valley, 5 miles northeast of the Silver Hill. These two mines have attracted a great deal of attention on account of the apparent richness of their ores, which are a complex mixture of galena, pyrite, sphalerite, chalcopyrite and quartz. The galena is rich in silver and near the upper surface of the Silver Hill, rich bunches of native silver were found, with the oxidized products of the primary sulphides. As the mining was carried deeper the unaltered sulphides were encountered and as the percentage of sphalerite (zinc blende) was high, mining became unprofitable. Pockets of pyrite were encountered that assayed over $200 in gold, while other portions of the pyrite only showed the presence of a trace of gold. Ores of this type are receiving the attention of metallurgists and it is not at all improbable but that these ores will in time be able to be worked profitably, if they occur in sufficient quantity.

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*Coining values are given.

The production of silver in 1901 was over twice that of the year before and amounted to $34,023.64 as compared with $15,986 in 1900, an increase of $18,037.64. This is the largest production that has been made for over 20 years. This large increase is partly due to the metal obtained from the copper ore of the Union copper mine at Gold Hill, and the larger production of copper ores in the Blue Wing district which contain some silver.

COPPER.

There has been a very material increase in the development and mining of the copper deposits of the State during 1901. The most important change in the copper situation is the addition to the list of producers of the mines of the Union Copper Mining Company at Gold Hill, Rowan county. The production has not only increased, but a number of mines have been thoroughly equipped and will become producers during 1902. Transportation facilities are greatly improved in the Blue Wing district and it is expected that the Ashe county deposits will soon have railroad connections.

The copper deposits of the State are for the most part in three distinct districts: the Virgilina or Blue Wing, which extends across Halifax county, Virginia, and Person and Granville counties, North Carolina; the Gold Hill of Rowan and Cabarrus counties; and the Ore Knob of Ashe county. Of these the first district has been the scene of the most development and the largest production.

OCCURRENCE.

*Virgilina District.**—The Virgilina or Blue Wing district consists of an area 20 miles in length and 3 miles or more in width; the mines for the most part being located on a rather flat-topped ridge rising 100 to 200 feet above the level of the surrounding valley. The country rock of this area is mainly what is known locally as greenstone or slate, which varies in color from dark green to grayish black. It is in fact an igneous rock of an andesite type, which has been crushed and metamorphosed. The fissures formed have been filled with metallic sulphides and gangue and are the veins that are now being worked and prospected. These fissure veins are dipping uniformly toward the east and have a strike nearly north and south (the general strike of the rocks being nearly 15 degrees east), and are approximately parallel to each other. They are sometimes cutting across the country rock and at other times are parallel to its schistosity. They vary in width from 2 to 15 feet, but the general average of those that are being most extensively worked are from 5 to 6 feet wide. Alteration of these ore deposits has extended to a depth of 25 to 40 feet and in some of the openings considerable malachite (green copper carbonate) is obtained. This alteration has not resulted in the formation of gossan, as this is usually understood, and the veins are comparatively firm and solid from the surface. There is some azurite (blue carbonate of copper) and cuprite (red oxide of copper) found in this zone of oxidation products and also rarely a little native copper. As the sulphide ores are encountered they are found to consist for the most part of chalcocite (gray copper or copper glance) and bornite (peacock copper). A very little chalcopyrite (copper pyrites or yellow copper) has been found along the western limits of the copper area. The gangue consists principally of quartz with some epidote, hematite and sparingly calcite. Gold and silver are also found in these ores in limited amount. The chalcocite ores are for the most part confined to the deposits in Person county and the bornite ores to those in Granville.

These veins are not found with a uniform width, but are all lenticular, although the largest veins have a continuous outcrop for a mile or more, and the underground workings show the vein to be continuous. They are, however, lenticular in form, widening and pinching both vertically and horizontally. This is the more noticeable in the smaller veins where the lenses of ore and quartz are connected with each other by simply a thin seam of quartz, which sometimes is lacking so that the vein has the appearance of giving out. These have been formed in part by the simple irregular fracturing of the metamorphosed schists, with a subsequent faulting, amounting to but a very few feet, which have produced the lenticular spaces that are now filled with quartz and ore, and calcite and ore. In some instances the faulting was complex and the result is a banded structure in the ore deposits, there being a succession of small seams or plates of the schist in the quartz gangue.

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*Am. Inst. Min. Eng.; Eng. and Min. Jour.

The most prominent mine of the district is the Holloway, 4 miles southwest of Virgilina, Va., on a spur of the Southern Railroad, and is owned by W. E. C. Eustis of Boston, Massachusetts. This is the most extensively developed mine in the district, and, while it represents a private enterprise, it is one of the most successful mining plants in the State. The mine has been worked to a depth of about 400 feet and the output shipped to a smelter at Norfolk, Virginia. The mine has been developed by four levels which have been run both north and south of the shaft for 100 feet at depths of 75, 150, 200 and 300 feet respectively. This work has shown the vein to vary greatly in width, being from 3 feet to about 100, and also illustrates the lenticular structure of the veins of this district, already referred to. The general trend of this Holloway vein is N. 15° to 20° E. With the present equipment of the mine, the output is about 50 tons of ore per day which is concentrated by hand-picking and cobbing to about one-half, which is shipped, the remainder being piled up awaiting some other means of concentration. This ore, which is more or less siliceous, is used to advantage at the smelter for fluxing with other ores low in silica.

The Blue Wing mine, formerly owned by the Boston and Carolina Copper Mining Company, and now controlled by Mr. John T. Williams of New York, is two miles south of Virgilina and was one of the first mines in this district to be developed. The mine is being thoroughly equipped and put in shape for shipping high grade concentrates. The ore deposit differs materially from the others of the district and is a splendid example of the complex fissure vein referred to above. The mine has been developed by means of a shaft that is about 180 feet deep with drifts running from the 100 and 150-foot levels. At the 100-foot level the drift extends 348 feet north and 115 feet south of the shaft and shows the vein to be nearly constant, 3 feet in width. From this level to the surface the ore has been pretty thoroughly stoped out. The ore consists of bornite in a gangue of quartz and calcite.

The mines of the Person Consolidated Copper and Gold Mining Company, 8 miles south of Virgilina, are on the same vein as the Holloway, but near the southern end of the belt. The two principal mines of the company are the Yancey and Durgy, the former being one of the oldest mines of the district. Several thousand tons of ore are on the dumps that was taken out during the development work of last year. The company are preparing to erect a concentrating mill of 50 to 75 tons capacity and it is confidently expected that copper concentrates will begin to be shipped during 1902.

The Arringdale mine is 7 miles a little west of south of Virgilina and the Morong 3½ miles south. Both of these mines are being developed by means of shafts and drifts, and are giving very encouraging results. Other mines that are being developed in the district are the Copper World, Warlick and Tingen mines. This district has now very much the appearance of a permanent and prosperous mining camp. All these ores contain more or less silver.

Gold Hill District.—The Gold Hill district is 14 miles southeast of Salisbury, beginning in the southeast corner of Rowan county and extending over into Cabarrus, a distance of 12 miles or more. The country rocks are chloritic and argillaceous schists and slates, striking about N. 25° to 30° E. and dipping 75° to 80° N. W. On the west of these schists there is an intrusive mass of granite and on the east metamorphosed dioritic rocks. The ore bodies consist of certain portions or bands of the schists or slates that are impregnated with auriferous pyrite and chalcopyrite and of imperfectly conformable lenticular lenses and stringers of quartz containing these sulphides. These have in some cases been successfully worked for gold. The principal mine in this district is that of the Union Copper Company, who have thoroughly equipped their mine with all modern machinery for mining and hoisting the ore and have erected a large concentrating plant and smelter. The mine is about 14 miles southeast of Salisbury and three miles from Gold Hill depot, which is on the Southern Railway, but is connected by a spur with this line. There has been expended in the neighborhood of $1,000,000 in the development of this property and the erection of buildings, etc., and this mine has become during 1901 one of the producers of copper.

The ore deposit has been developed by means of 12 shafts of varying depths, the deepest one being 800 feet. The ore consists principally of chalcopyrite, with occasionally a little bornite and pyrite, in a gangue of quartz. The mine is being worked by means of a vertical shaft 520 feet deep which is connected with a 430-foot inclined shaft; and by two separate vertical shafts, one 305 feet deep and the other 225 deep. Besides these working shafts there are 8 shafts ranging from 150 to 200 feet that were sunk during the development of the mine. The ore carries, besides copper, considerable values in gold and silver. The ore, as it comes from the mine, is sorted and the lower grades crushed and rolled and then concentrated. The concentrates, together with the selected ore, are roasted and then smelted to a matte containing 50 per cent. of copper and the gold and silver. This matte is shipped north for refinement.

Another mine in the Gold Hill district or belt is the Cruse mine, which is in Cabarrus county, about 10 miles northeast from Concord, the county-seat, and 12 miles nearly south from Gold Hill. Concord is the nearest railroad station. The ore occurs in a series of quartz lenses, having a width of from 1 to 3 feet and dipping about 555° to the east, but pitching a little toward the northwest. These lenses all have fairly sharp boundaries and in some cases are entirely separated from each other, while at other times they are connected by thin stringers of quartz. Their general strike is N. 35° W. and they can be traced almost continuously for about 600 feet. The vein has been developed by means of three shafts, 140 feet, 40 feet and 35 feet respectively in depth and by a number of small pits. The 140-foot shaft was in ore the whole distance, the vein varying in width from 15 to 30 inches. At a depth of 75 feet a drift was run 20 feet to the southeast, which showed the vein to practically pinch out in that direction. At the bottom of the shaft another drift was run to the southeast, which also showed the vein to nearly pinch out. Toward the northwest, however, as far as the work has been continued, which was 15 or 20 feet, the vein holds its own width. Hugging the foot wall at the bottom of the shaft was a seam of nearly pure chalcopyrite from 3 to 4 inches in width and this has been nearly continuous throughout the whole depth of the shaft. The rest of the vein had the chalcopyrite scattered sparingly through it in small bunches and particles. The other vein minerals were siderite (iron carbonate), which occurred in considerable quantity, hematite and pyrite in a gangue of quartz. Particles of chalcopyrite were also observed impregnating the country rock in some places for a distance of 7 feet from the vein. For a few feet each side of the vein, the wall rock is more or less impregnated with small seams and stringers of quartz that are apparently following the schistosity. The other two shafts encountered similar lenses f ore.

There are a number of other copper mines and properties in the vicinity of Gold Hill and Salibsury, as the Conrad Hill mine, 6 miles southeast of Lexington; the Gold Knob, 9 miles, and the Reimer, 6 miles southeast of Salisbury on the Yadkin river; and the Bullion, one-half a mile east of the Reimer. These properties should be able to be worked, if favorable railroad rates can be obtained for shipping their ore to the smelter of the Union Copper Company at Gold Hill. Many of these ores carry good values in gold and silver.

Ore Knob District.—In the Ore Knob district the principal mines are the Elk Creek, Copper Knob, and Ore Knob. Of these the Ore Knob mine was successfully worked as long as the oxidized products lasted. This Ore Knob mine is situated near New river, Ashe county. The ore deposit is a fissure vein with a strike N. 60° E., cutting the gneisses and mica schists comprising the country rock. The vein is from 6 to 14 feet wide and has been altered to a depth of about 40 to 70 feet. A strong iron goasan is encountered, beneath which, and between it and the sulphides, is an iron-black, friable and crystalline ore, carrying as high as 36 per cent. of copper. This ore is from 20 to 30 feet deep when the sulphide ores were encountered, which consisted of chalcopyrite with magnetite, pyrrhotite, and pyrite in quartz. This property is now being developed by the Garretson Southern Furnace Company, who are erecting a smelter and reduction works and expect to become producers of copper during 1902. The property has been developed by means of 8 shafts aggregating 854 feet and by 1,276 feet of levels. It has been estimated by the company that they have 150,000 tons of a 2 per cent. ore lying on the dumps.

The Peach Bottom Copper Company are developing the Elk Creek or Elk Knob mine on Elk creek, Alleghany county, by means of two shafts, one 140 feet and the other 170 feet in depth. The ore deposits are similar to those of Ore Knob and the work that has been done in this district shows ores to be in quantity, but of low grade.

In Jackson county there has been some development work carried on by the Cullowhee Copper Company at Forest Hill, near Cullowhee. In Swain county the Everett Mining Company has done some extensive development work on the copper property at Hazel creek near Medlin, and are erecting a smelter. Sufficient work has not as yet been done at either of these properties to actually determine their value. The ores are chalcopyrite. In Crab Orchard township, Mecklenburg county, the Vista Copper mine is being developed with some success. In Chatham county, about 2 miles southeast of Harpers Cross Roads on the Nat Phillips farm, some prospecting and development work has been done in 1901. One shaft 80 feet deep has been sunk which encountered a 12-inch seam of chalcocite (gray copper) ore at the surface which widened to over 3 feet at the bottom.

The custom smelter of the Union Copper Company at Gold Hill and the proposed one of the Blue Wing district will be of material advantage to the development of copper properties in their respective vicinities. With the price of copper at 12 cents per pound, as it was at the beginning of 1902, there must be the more favorable conditions for mining and smelting of the ore; but even at this price, copper mining should be a good, profitable industry in the State. This reduction in price of copper does not mean a less demand, for this is constantly increasing, but with the increased number of producing mines and the fact that a number of the large users of copper are also now miners of this metal, it is not at all improbable but that the price will remain in the neighborhood of 12 cents per pound for some time to come.

During 1901 there were 10,398 tons of copper ore mined which were valued at $76,900 as compared with 6,948 tons valued at $41,600 in 1900. This is a decided increase in the production and is largely due to the Gold Hill district. Considering the amount of substantial work that is being done at the different copper mines, the production should be greatly increased in 1902.

IRON.*

The iron ores are very widely distributed over the State and include magnetite (the magnetic oxide of iron), hematite (the red oxide), limonite (the yellow oxide), and bog iron ores. Siderite or spathic iron occurs sparingly at a number of iron mines.

On account of the low prices of iron, many points have to be carefully considered regarding the ore in order to determine whether it can be profitably mined; and these are its chemical composition, mechanical structure, proximity to a supply of fuel, flux and water, and relation of the cost to the market price.

The first is by far the most important, for the first thing to determine is what percentage of iron the ore will carry, and how free it is from the injurious elements, sulphur, phosphorous, and titanium. There are a number of minerals that contain a high percentage of iron that will not make profitable iron ores, and very high percentage of iron in a mineral deposit does not necessarily mean a good iron ore. Many attempts have been made to use the titanic iron ores, but they have resulted in complete failure and loss. The titanic acid of the ore passes into the slag, making it very difficult of fusion, and 1 per cent. of titanic acid in the ore will condemn it. Sulphur is injurious in an ore, for it cannot all be eliminated from the pig-iron, and renders it red-short, that is, brittle when hot; and phosphorous goes pertially into the pig-iron, making it cold-short, that is, brittle when cold. Nearly all of the iron ores in North Carolina are low in sulphur, while those carrying titanium are usually confined to the magnetic ores.

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*See also Bulletin 1, 1893, N. C. Geol. Survey, Iron ores of N. C.

The mechanical structure of the ore is also important, for the value of the iron increases or decreases according to the amount of gangue removed in mining the ore, and also the amount of cleaning that is necessary before the iron is ready for smelting, and the amount of foreign material that has to pass through the furnace. It is often of serious importance to determine whether it is cheaper to smelt the ore where it is mined or transport it to a furnace erected near the source of fuel and flux.

The history of iron mining in North Carolina dates back to as early as 1729, when small shipments of iron were made to England. The ore first mined was probably the bog ores near the coast. Mining for iron almost kept pace with the settlement of the western portion of the State. The remains of the old workings are still visible, but they do not indicate that because they have been worked there is a quantity of ore, or because they have been closed, the ore gave out. They would all have to be examined to prove them one way or the other.

Some of the principal iron localities are: The magnetite ores of Granville, Stokes, Surry, Catawba, Ashe and Mitchell counties; the limonite ores of Chatham, Gaston and Cherokee counties; and the hematite ores of Granville county, these being confined principally to the Piedmont Plateau and Mountain regions. Geologically, the magnetites and hematites are confined almost exclusively to the crystalline rocks. Some limonites are also found in these rocks as well as in the Ocoee formation of Madison and Cherokee counties. Limonite ores (bog-iron ores) are also found in the more recent formations of the Costal Plain region.

The most noted iron mine in the State is the magnetite iron mine at Cranberry, Mitchell county, which is at the terminus of the East Tennessee and Western North Carolina Railroad. The ore body consists of an immense lens of magnetite that has associated with it hornblende, pyroxene, epidote, quartz, feldspar, calcite, garnet, zircon, allanite, serpentine, etc., in varying proportions. The ore is distributed in irregular masses through the gangue and at times intimately associated with the same in thin bands. The thickness and extent of these bands are variable, from a few inches to more than fifty feet.

Nearly all the iron produced in 1901 was from this mine, and amounted to 2,578 tons valued at $4,997, as compared with a production of 21,000 tons in 1900 valued at $42,000. The Cranberry mine was not operated for the greater part of the year, the time being spent in development work and improvements to the plant. It is expected that in 1902 there will be a constant output per month that will make the total production for the year greater than that of 1900. The other mine producing iron in 1901 was the Potato creek mine, located in the Piney Creek district, Alleghany county, and contains magnetic ore.

The large iron deposits in Ashe county are reported to have been purchased by the Pennsylvania Iron Company, who contemplate beginning extensive operations in the near future.

The shutting down of the large blast furnace of the Empire Steel and Iron Company at Greensboro has been the cause of the closing down of the mines in the eastern and central part of the State. It is reported on good authority that this furnace will again be in operation before the end of 1902.

While at the present time the iron ores of the State are adding but little to its wealth, yet they do represent reserved sources of wealth that will in time be available. The competition with the Lake Superior iron ores that has effectually closed the North Carolina mines is not permanent, for their deposits are limited in extent, and unless new sources of supply are found in the immediate vicinity, other known iron ores will become available.

MANGANESE.

While there has been but a few sample car loads of manganese ore shipped from the State, there has been considerable prospecting for this ore. The principal work has been done near Brevard, Transylvania county; Canton, Haywood county; and near Goldsboro, Wayne county. While as yet no large deposit has been definitely located, these three are promising occurrences.

The deposit in Transylvania county is about 7 miles northeast of Brevard and 3½ miles from Blantyre, a station on the Transylvania Railroad. The deposit has been developed by means of 7 shafts along the strike of the vein in a distance of 2,000 feet; and near one shaft the vein was exposed for 200 feet. The deposit has been estimated to be 18 feet wide, and is capped for a distance of 10 feet by limonite, which does not carry more than a trace of manganese oxide. Below this point the manganese oxides begin to come in, with the iron minerals predominating in the ratio of 5 to 1. These are so arranged, however, that the limonite is readily eliminated by hand-cobbing. The strike of the vein is in a general N. E.-S. W. direction, and it is dipping toward the east. Assays of this ore show it to vary from 22 to 57 per cent. of manganese, these representing two samples, one which was considered the poorest ore encountered and the other the best. An average sample of the ore, after cobbing to eliminate the yellow limonite, will contain from 45 to 50 per cent. of manganese.

Six samples representing various types of ore from this deposit gave the following results when analyzed:

ANALYSIS OF MANGANESE ORE FROM NEAR BREVARD.

	Iron (Fe).	Phosphorus (P).	Silicon (Si).	Manganese (Mn).
1	16.01	.037	1.56	43.93
2	3.26	.071	.39	57.02
3	13.44	.109	.93	45.08
4	32.37	.207	3.32	22.54
5	5.68	.227	1.34	48.66
6	32.02	.505	1.25	25.34

Samples 1, 2, 3 and 5 all show a high per cent. of manganese, and with the exception of No. 5 are low in phosporous and silicon. The portions of the ore deposit that are like Nos. 4 and 6 can be as a rule readily eliminated, so that the manganese contents of the commercial ore are kept high.

This is one of the more promising manganese properties in the State and has been developed by Mr. Robert Harris of Franklin, North Carolina.

The Haywood county deposit is located in Beaver Dam township, two miles southwest of Canton, on land of J. B. Rhodarmer and S. W. Smathers of Canton. Manganese ore has been found as float pieces over an area of about 300 feet wide and nearly a quarter of a mile in length, starting from a flat near the tobacco barn (west of the house) and extending in a northeast direction. The better samples of ore have been found nearer the southwest end. The only development work that has been done is a small cut in bank of road and parallel to it, about 40 feet long, which exposed a number of streaks of manganese ore, covering not over one-sixth of the exposed surface. At the west end of this cut a shallow pit 4 feet deep showed the streaks of ore to increase in width.

Only a very small percentage of the ore exposed is hard and compact and this was found mostly in the pit. Most of the ore is soft and friable and considerable of it is mixed with limonite. Near the northeast boundary of where float ore has been found, a streak of limonite mixed with manganese oxide was observed in the bed of a brook. This point is thirty or more feet higher than the cut and the manganese ore is overlaid by a blueish pipe clay.

Assays were made of this ore as follows: 1, of the hard compact ore from open cut; 2, soft friable ore from cut; 3, ore mixed with limonite; 4, ore from northeast boundary.

	PER CENT. MANGANESE.
1	51.93
2	3.77
3	3.55
4	10.80

Near Goldsboro, Wayne county, a deposit of manganese is being investigated by Mr. S. G. Fry of Goldsboro. The ore on the surface has been assayed and gave the following results:

	PER CENT. MANGANESE.
Compact black ore	13.4
Pink silicate	17.9

Many of the black masses of ore when broken open were found to contain this pink mineral, which fuses readily before the blow-pipe, to a black magnetic bead. A complete analysis was made of this mineral with the following results:

ANALYSIS OF SPESSARTITE FROM NEAR GOLDSBORO, NORTH CAROLINA.

Specific gravity, 4, 041.	PER CENT.
SiO_2	38. 86
Al_2O_3	19. 86
FeO	13. 81
TiO_2	. 52
P_2O_5	. 39
MnO	20. 16
CaO	4. 27
MgO	2. 24
H_2O	. 36

This analysis shows the mineral to be spessartite, the manganese garnet.

It is not at all improbable but that as these properties are developed the manganese ore will be found to exist in quantity.

The value of a manganese ore varies with its percentage of this metal, and to be readily marketable it must contain at least 40 per cent., and be low in phosporous. The price of these ores quoted at New York is $ per ton for a 50 per cent. ore; for every unit (per cent.) less than this the value decreases; but for every unit above 50 per cent. there is a corresponding increase in the value of the ore.

PYRITE.

The mineral pyrite, a sulphide of iron (FeS_2) has been mined for the manufacture of sulphuric acid. The principal deposit is the Oliver mine, 4 miles from Crouse, Gaston county. This mine has recently been purchased by the Virginia-Carolina Chemical Company and it is very probable that the mine will not be operated for the present.

Near Toxaway, Transylvania county, a deposit of pyrite has been found by Dr. W. C. Fisher which gives indications of containing this mineral in quantity.

As a by-product in gold mining, the sulphuret concentrates, which are too low in gold to be treated either by the cyanide or chlorination process, offer a possibility of being profitably used for the manufacture of sulphuric acid. This is the intention of the Whitney Reduction Company of Gold Hill, who will have a large quantity of sulphurets which are too low in gold to be of value for the extraction of this metal.

The production of pyrite in 1901 was 4,000 tons valued at $32,000, while in 1900 the production was 4,500 tons valued at $14,625. This increase in the value of the ore was due to its higher percentage of sulphur.

CORUNDUM.

Corundum is a mineral that was formerly supposed to occur but sparingly in nature, but is now known to be quite wide in its occurrence. It has been found in North Carolina associated with peridotite, pyroxenite, amphibolite, anorthosite, serpentine, gneiss, mica-schist, quartz-schist, amphibole-schist and chlorite-schist. Of all these the most common occurrence is corundum in peridotite, During 1901 corundum deposits were mined which occurred in peridotite, quartz-schist and chlorite-schist. In recent years attempts have also been made to mine corundum in amphibolite, gneiss and amphibole-schist, but in every instance they could not be successfully operated either on account of the low percentage of corundum in the rock, or on account of the refractory nature of the rock, or the erratic occurrence of the corundum, which in a number of instances gave out entirely. In a few instances where the corundum occurred in the decomposed portion of the rock so that it could be separated by sluicing they were successfully worked, but as soon as the hard rock was encountered the mine had to shut down.

There are three names in constant use to designate the varieties of corundum: 1. Sapphire, which includes all of those corundums that are transparent to semi-transparent, of whatever color; 2. Corundum, including the translucent to opaque, of all colors; 3. Emery, which is a mechanical admixture of corundum and magnetite or hematite. The last two varieties are those used in the arts, for abrasive purposes; the emery being used in very much larger quantity than the corundum. It is of course the presence of corundum in the emery that gives it its abrasive qualities and makes it of commercial value, and the abrasive efficiency of the emeries will vary according to their percentage of corundum.

Any corundum that is transparent is brought under the head of sapphire, although many of these have distinct names in the gem trade. These are taken up under the head of gems. The corundum gem or sapphire localities are usually distinct from those of corundum, although some very handsome gems have been found in some of the mines where corundum was mined for abrasive purposes, notably the Corundum Hill, at Cullasaja, Macon county.

OCCURRENCE.

Corundum, as it is mined for abrasive purposes, occurs as sand, crystal or gravel, and block corundum, sometimes all three types being found in the same deposit. The sand corundum consists of small grains, crystals or fragments of mineral scattered through the vein. The crystal corundum consists of crystals up to three inches in length. Often these crystals have parting planes so thoroughly developed that they often cause the corundum in crushing to break up into regular rhombohedrons, this continuing even to the finer sizes, which causes the grains to break down when in use. This continued regular breaking destroys the cutting efficiency, which is dependent on its irregular fracture, which produces the best cutting edge. The block corundum often occurs in masses from ten to a thousand pounds in weight of almost pure corundum. Then again, it occurs in large masses intimately associated with hornblende, feldspar, etc., making a very tough and difficult rock to work. Often the only way to break these masses is to build fires over them and then to suddenly cool them by pouring water upon them. The parting planes are at times very noticeable in the block corundum and are detrimental to the commercial product in the same way as to the crystal corundum.

There is a constant demand for corundum, more at the present time than is being supplied, and this has caused more thorough prospecting to be undertaken for this mineral. Although there are over 60 localities known in North Carolina where corundum occurs, which extend over a considerable portion of the western part of the State, it is at present only known to occur in commercial quantity in the four counties, Clay, Macon, Jackson and Transylvania. These corundum deposits are unquestionably of great economic importance to the State, and considering the energy with which the industry is now being pushed, it will be but a short time when the corundum will be bringing a considerable income into the State. The principal mines are the Corundum Hill at Cullasaja and the Mincey at Ellijay, Macon county, the Buck Creek or Cullakeenee, Clay county; the Socrates, Bad Creek, and White Water near Sapphire, Jackson county; and the Burnt Rock and Brockton in Transylvania county, the corundum at all these being associated with peridotites; the Scaly mountain in Clay county, where the corundum is associated with quartz schist; and the Caney Creek mine in Jackson county, where the corundum occurs in a chlorite schist. Besides these, there are a number of other deposits that are being developed and others that are promising prospects, as the property of the North Carolina Corundum Company on Little Buck creek, Clay county; the Gray and Robinson properties on Ellijay creek, Macon county; a deposit in Woodfin Cove, Balsam Mountain, near Hall, Jackson county; the Corbin and Grimshawe properties near Montvale, Transylvania county; and the Carter mine, Madison county, near Democrat, Buncombe county.

The only mines that have produced any quantity of corundum during the past year are: The Corundum Hill mine at Cullasaja, Macon county, whose production has been smaller than usual, and which after being cleaned was shipped to Chester, Massachusetts, where it was sized and prepared for market; the Scaly mountain mine in Clay county, which has for the first time produced corundum for the market, it being cleaned and sized at the mine; and the Caney Creek mine, Jackson county.

The North Carolina Corundum Company have done considerable development work on their property at Little Buck creek, Clay county, and they report very encouraging results regarding the amount of corundum exposed. The Toxaway Company, who own most of the mines in the vicinity of Sapphire, Jackson county, have done a little work on their corundum deposits, sufficient, however, to expose the corundum at the Brockton mine and on the Corbin property. The National Abrasive Manufacturing Company own the corundum deposit on Caney creek, Jackson county, where the corundum occurs in a mica and chlorite-schist, and the work that they have done here, while not actually demonstrating the quantity of corundum, does show that it is of good quality, and that it will make a good wheel.

USES.

The uses of corundum are very limited and can be divided into two general heads—gems and abrasives.

Both corundum and emery are used in the manufacture of abrasive materials, and these are on the market in three forms—as wheels and blocks of various shapes and sizes; as emery paper; and as the grains or powder. The last two need no further explanation.

The shapes of the corundum and emery wheels and bricks, or stones, are very varied, being adapted to all kinds of grinding. The principle of these wheels is the same as that of the rotary file, and as the points of a file become dull from using, so also do the grains or points of the emery and corundum in the wheel. It is necessary, therefore, in making a wheel that it be made of such a temper or grade that when these grains become dull or rounded they will fall away or will be readily removed by a truing tool, leaving fresh sharp ones exposed. The grade of a wheel depends upon the character of the work for which it is to be used, and the bond should be such that it will wear away a little faster than the emery or corundum, and thereby always leave the sharp edges ready for cutting. The greatest economy results when the bond does not wear away until the grains of emery or corundum have become rounded and dulled.

There are three types of wheels known to the trade—the vitrified, chemical, and cement—the names being derived from the processes by which they are manufactured. In the manufacture of all of them the corundum or emery used is in grains of uniform size, but these vary with the grade of wheel to be made. The vitrified wheel is the most important and the one more generally used, although for some work one of the others is often preferable, and for the manufacture of very large ones the commercial wheel is especially adapted.

Where formerly North Carolina and Georgia were the only States that were producing corundum, and all the deposits were occurring in peridotite, this mineral is now being mined in Ontario, Canada, and in Montana, where the mineral occurs in syenite, and the former mine is shipping considerable quanitites of this mineral into the United States. The Montana mines expect to put corundum on the market during 1902. These two deposits will be strong competitors of North Carolina corundum, but there should be no difficulty for the North Carolina deposits to compete with them, for the corundum is as good quality. While the market for corundum is a limited one, and there could be easily an oversupply, yet with a reduction in price for this mineral, there would be a correspondingly increase in the demand, which would be at the expense of emery. The artificial abrasives, carborundum and artificial corundum, are competitors of corundum and this is especially true with corundum at its present price. There has been a constantly increasing demand for abrasives and there will continue to be an increase just so long as our manufacturing industries continue to grow. There will be changes in the abrasive industry, but it will not be in a reduction of the production of abrasives, but in the kind of abrasives that will be used. As corundum has the highest abrasive efficiency of all the natural abrasives, it will be more in demand, if the price can be kept sufficiently low.

In 1901 the production of corundum was 325 tons valued at $48,840, which is an increase of 120 tons and of $12,000 in value over that of 1900, the production of which was 205 tons valued at $36,840. This increase is due principally to the production of the Sealy Mountain mine. With, however, the amount of this mineral that is known to exist in the State and the demand that there is for it, there should be five times this amount produced.

GARNET.

The name garnet is used to designate a group of minerals which have many identical and similar physical properties and similar chemical properties. They all crystallize in the isometric system, with the dodecahedron and trapezohedron as the common forms.

They vary in specific gravity and color according to their chemical composition. The different minerals that have been identified as belonging to the garnet group are given in the following table, together with their chemical composition, specific gravity and hardness:

LIST OF GARNETS.

Garnet.	Chemical Composition.	Specific Gravity.	Hardness.
Grossularite (Calcium—aluminum garnet)	$Ca_3Al_2Si_3O_{12}$	3.55—3.66	6.5—7.5
Pyrope (Magnesium—aluminum garnet)	$Mg_3Al_2Si_3O_{12}$	3.6 —3.7	6.5—7.5
Almandite (Iron—aluminum garnet)	$Fe_3Al_2Si_3O_{12}$	4. —4.15	7. —7.5
Rhodolite (Magnesium—iron—aluminum garnet)	$2Mg_3Al_2Si_3O_{12}$ $Fe_3Al_2Si_3O_{12}$	3.83	7.5
Spessartite (Manganese—aluminum garnet)	$Mn_3Al_2Si_3O_{12}$	4.2	7. —7.5
Andradite (Calcium—iron garnet)	$Ca_3Fe_2Si_3O_{12}$	3.8 —3.9	7.
Uvarovite (Calcium—chromium garnet)	$Ca_3Cr_2Si_3O_{12}$	3.41—3 52	7.5

Of the above garnets, those that are used as abrasives are pyrope, almandite and andradite. In the above table the theoretical composition is given for the different varieties, but they will be found to vary, as ferrous iron, calcium, magnesium and manganese are isormorphous with each other and are capable of replacing each other, which is also the case with ferric iron and aluminum. As is seen, the hardness of the different garnets varies from 6.5 to 7.5. The uses of garnet are in the manufacture of sand-paper or "garnet paper" which is used extensively by boot and shoe manufacturers; and in the manufacture of abrasive wheels which are sold as emery or corundum wheels. Practically all the garnet mined in North Carolina is used for this latter purpose, and is the almandite variety. Its abrasive efficiency is good, and for some kinds of grinding it is especially adapted, but on account of its low fusibility, it cannot be used in the manufacture of the vitrified wheel. Garnets are also used as gems, and these are described beyond.

Garnet is one of the most widely distributed minerals and is found in many of the crystalline rocks. It is commonly associated with mica (muscovite) in pegmatitic dikes, although sometimes but sparingly; and often occurs abundantly in gneisses and schists. Bands of these rocks often contain a large percentage of garnet while the enclosing rock contains practically none; and it is the occurrences in these bands that constitute for the most part the commercial sources of this mineral.

There are a number of localities in North Carolina that have been worked for garnet with considerable success. For the most part the occurrences are similar, being bands of garnetiferous-gneiss in ordinary gneiss, which are up to 50 or more feet in width and some of which average 30 per cent. of garnet.

The principal deposits are in Jackson county, one, the Sugar Loaf mine, being near the summit of Sugar Loaf Mountain, 1½ miles from Hall, a station on the Murphy branch of the Southern Railroad. Another, the Savannah mine, is on the head-waters of Betty creek on the east slopes of the Cowee mountains. The third is the Presley near Speedwell in the upper Tuckaseegee valley, about 12 miles from Sylva on the Southern Railroad. The garnet at all three of these localities is the almandite variety and some of it has been sold under the name of ruby corundum. On the slopes of Scaly Mountain in Clay county, there are bands of quartz-schist that are corundum and garnet-bearing, which are being mined for corundum and the garnet is saved as a by-product. About 5 miles west of Spruce Pine, Mitchell county, near the Burnsville road, there is a large deposit of massive garnet that occurs in pockets in a geissic rock. Associated with this garnet there is considerable epidote. At the present time its distance, 25 miles from the railroad, prevents its being an available source of garnet. With, however, the completion of the railroad that is now being built through Yancey and Mitchell counties, these deposits may prove to be of some considerable commercial value.

The principal production of garnet for abrasive purposes during the past two years has been confined to Jackson county and the two mines that have been worked exclusively for this mineral are the Sugar Loaf and the Presley. A small amount of garnet has been produced in 1901 as a by-product from the corundum mine on Scaly mountain, Clay county. The total production of garnet in 1901 was 775 tons valued at $43,000 as compared with 300 tons valued at $18,000 in 1900.

The plant at the Sugar Loaf mine is being increased and the production of garnet in 1902 will very probably be much larger than in 1901.

MICA.

OCCURRENCE.

It is the varieties of mica known as muscovite and phlogopite to which all the commercial mica belongs, and in North Carolina it is the muscovite mica that is commonly found. It is very widely distributed, being a component of many of the crystalline and sedimentary rocks. When, however, it occurs in blocks or masses which can be split into sheets an inch or more in diameter, it has a commercial value which increases with the size of the cut sheets and these vary from 1x1 to 8x10 inches. These deposits of commercial mica occur for the most part in pegmatitic dikes or veins which are found in granite and in hornblende and mica gneisses and schists. These dikes or veins, which vary in thickness from a few inches to several hundred feet, are often very irregular and have arms or "veinlets" branching off from them in many directions. At times they are parallel to the bedding or schistosity of the gneiss or schist and again they break across this at varying angles; both of these phenomenon often being observed in the same dike.

In character these pegmatitic dikes are very similar to a granite and sometimes they are called "coarse granite"; and if we could conceive of the constituents of the granite being magnified a hundred times or more, we would have an appearance that would be very similar to a pegmatitic dike. These dikes consist of quartz, feldspar and muscovite-mica in varying proportions. In some portions of the dike or vein the quartz and feldspar are nearly equally distributed, while in others sometimes one and again the other will predominate. Feldspar has been observed that has crystallized out in masses of more than a ton in weight, and well developed crystals of this mineral have been observed that were 3x11½ feet. Sometimes the feldspar, quartz and mica have separated out in rather small masses while at others they are separated out on a much larger scale. As far as I have observed the occurrence of mica, the veins that yield the best commercial mica are those in which the three minerals have crystallized out in the larger masses. Where the feldspar and quartz are rather small, the mica is apt to be small and often is of poor quality. All the mica veins do not carry commercial mica, and usually the dikes two feet and less in width are barren of mica that would have a commercial value. Still, on the other hand, all the wide veins do not carry a mica that would make profitable mining, for in some, the mica is in such small crystals and blocks, that sheets cannot be cut over an inch or two in diameter.

Regarding the mica itself as it occurs in the vein, it is usually in rough crystals called blocks or books, distributed sometimes nearly evenly in the vein and at others nearer the contact of the vein with the country rock. These blocks of mica are sometimes nearly perfect in their crystalline form which is monoclinic, but rhombic or hexagonal in outline. While these blocks usually vary in thickness from 3 to 15 inches in diameter and 1 to 18 inches in thickness, they have been found as much as four feet in diameter. These blocks have at times been converted into what is called ruled mica, the mica being cut into narrow strips whose edges are parallel to the intersection of the prism and base edges of the crystal, or "A" mica, where the sheets are striated on two adjacent edges. The percentage of mica in these pegmatitic dikes will seldom, if ever, average over 10 per cent. of the contents of the dike and it will sometimes not be over 1 per cent. Often the dike will have the apparance of containing a very much larger percentage, on account of a number of blocks of mica being clustered together in bunches and almost touching one another; while in other portions of this same dike, there may be an absence of mica for a distance of from 5 to 20 feet and thus the general average of mica in the dike will correspond to 1 to 10 per cent.

The principal deposits of mica in North Carolina are in Mitchell, Yancey, Jackson, Haywood and Macon counties, the two former having the larger proportion. In Mitchell county there are 66 and in Yancey 45 mines. These mines have been worked for the most part by crude methods, but even under these conditions, the Clarissa, Sinkhole, Hawk, Double Head, Spread Eagle, Deake and Cloudland mines in Mitchell county; the Ray mine in Yancey county; the Big

Ridge and Shiny mines in Haywood county; and the Iola, Burningtown, and Raby mines in Macon county have produced collectively considerably more than a million dollars worth of mica, and it is not unreasonable to suppose that under more favorable conditions the supply will be greater than what it has been in the past. Many of these old mines are now being reopened and worked with considerable success. North Carolina mica is still, as it always has been, superior to any other in the world.

ASSOCIATED MINERALS.

There are a number of minerals that occur associated with the mica in these pegmatitic dikes, some of which have a commercial value, principally as gems, and these are taken up on page 50. Below is given a list of the minerals that have been found in these pegmatitic dikes and those marked with an asterisk have been obtained in sufficient quantity to be of value commercially.

LIST OF MINERALS FOUND IN THE PEGMATITIC DIKES OF NORTH CAROLINA.

Quartz* (massive, crystallized, and smoky).
Albite.*
Oligoclase.
Orthoclase.* } Feldspars.
Microline.*
Kaolin.*
Muscovite.* } Micas.
Bootite.
Beryl* (emerald, yellow and aquamarine).
Almandite.
Andradite. } Garnets.
Tourmaline.
Zoisite (var. thulite).
Epidote.
Enstatite.
Actinolite.
Cyanite.
Pyrophyllite.
Allanite.
Chabazite.
Zircon.*
Magnetite.
Gahnite.
Hematite.
Menaccanite.
Limonite.
Rutile.
Opal (var. hyalite).
Pyrite.
Molybdenite.
Pyrrhotite.
Uraninite.*
Gummite.*
Autunite.
Uranotil.
Phosphuranylite.
Columbite.
Samarskite.*
Rogersite.
Hatchettolite.
Fergusonite.
Monazite.
Apatite.
Graphite.

The majority of these minerals are found in the mica mines or pegmatitic dikes of Mitchell, Yancey and Madison counties. In the other mica-producing counties the associated minerals are less in number and rarer.

A number of these by-product minerals are gems; but there are two, feldspar and quartz, that may become of some considerable value, especially the former. This is used in pottery manufacture and by utilizing the available water-powers for grinding it, it should be able to be placed on the market at a fair profit. There are a number of the mines in Yancey county and also Mitchell county that could furnish it in quantity. In the more southern counties the feldspar has usually suffered too much kaolinization to be of value for this purpose.

Uses.

Besides the use of mica for cutting into sheets of varying sizes, which are used for stoves, chimneys for the incandescent lights, etc., there is a large quantity of the smaller pieces of mica that are cut by machines into small circular disks (one inch in diameter), and rectangular pieces ¾x2 inches which are used for insulation purposes in electrical apparatus. While the use for stoves has decreased very rapidly during the past ten years, there has been a corresponding increase in its use for electrical apparatus. Of all the mica that is mined, there is probably not over 10 to 15 per cent. that can be cut into sheet mica, the rest being waste or scrap mica. In some of the mines in the western part of the United States there is hardly a 3 per cent. yield of cut mica. In the North Carolina mines, the mica obtained will average the highest percentage of cut mica. Selected masses or blocks of mica will often average from 30 to 40 per cent. and occasionally as high as 75 per cent. There are a number of reasons for this large percentage of waste mica: The irregularity of the blocks of mica, and of the individual sheets; the "ruled" and "A" mica reduce the size of sheets that can be cut; or prevent entirely any sheets being cut from the block; specked and stained mica; and the destruction of sheet mica by having garnet, tourmaline or quartz crystallized out between the foliæ. Some of the small perfect pieces of mica from the cutting of the large sheets are re-arranged and cemented together into larger sheets, which are cut into various shapes and are known as micanite. For some purposes the large sheets of micanite answer as well as the perfect sheets and are of course much cheaper. The waste or scrap mica, which is not suitable for any of the above purposes, has a value when ground to a flour as in the manufacture of wall papers, lubricants, etc. Another use for scrap mica that has been devised during the past few years is in the manufacture of a covering for boiler-tubes and steam pipes in general. The scraps of mica are not ground but are broken to approximately the same general dimension—about one-half by a quarter of an inch. These are arranged with their longer direction and face parallel to the length of the coil, which consists of a wire net, pressed into the shape of the pipe or tube and against which is the layer of scrap mica kept tightly in place by means of heavy canvas. This kind of boiler-tube covering can be cheaply made and as mica is a non-conductor of heat, it should give good satisfaction, if not equal to or better than the asbestos coverings. North Carolina offers a very favorable location for a plant to manufacture these as it can produce a large supply of scrap mica and has also an abundant supply of available water-power. It is the commercial value of this scrap mica, which is from $8 to $10 per ton delivered at the railroad, that has made it possible to work some of the mines that would otherwise have been unprofitable; for it must be remembered that this waste mica represents 75 to 95 per cent. of the mica mined.

The value of the plate mica per pound varies with the size of the sheet, which is from 15 cents for the smaller sizes to $3 and more for the larger.

LOCALITIES.

During the past year, many of the mica mines throughout the State have been worked quite vigorously, and the result is a larger production of sheet mica than for many years past. The production, however, of scrap mica was less, this being due to the fact that for a number of years the old dumps at the mica mines have been a fruitful source of scrap mica; but as these have been more or less thoroughly culled over, the production is now largely the waste from present mining. There have been a large number of small producers (from $50 to $500) in the different counties that have worked their mines a few days at a time. There are but few that have been worked continuously throughout the year. A number of new properties, and also old mines, have begun to be worked during the past year, as the mines of the Carolina Mining Company on Beaver creek, near Jefferson, Ashe county; the Mattocks mine near Canton, Haywood county, which is being operated by Mr. J. E. Mattocks; and the Reeves mine near Montvale, Transylvania county. The mica that is being produced in the State does not begin to represent what it should be. By the consolidation of many of the mica mines they could be put on a paying basis and would be profitable to the investor, while by the present method of mining many of them do not more than pay expenses. There are many good deposits of mica in the State that can be worked to advantage and as these are taken up and mining operations for mica are carried on to the same extent as in other kinds of mining, they will be found to be as profitable.

There is no method by which it can be accurately determined from the appearance of a pegmatitic dike at the surface, whether or not at greater depths it will contain large blocks of mica and make profitable mining; but if there is a considerable exposure of the surface dike, and if in this distance there are indications of large blocks of mica, or of mica in paying quantity, it can usually be considered that this represents what will be found deeper. There are a few facts, however, regarding mining and prospecting for mica that can be used to advantage which have been enumerated by Prof. J. A. Holmes as follows:

"Deposits of commercial mica are most likely to be found:

"(1). In regions where the country rock is either mica schist, hornblende schist, or a somewhat schistose gneiss.

"(2). In such of these regions as where the crystalline schists and gneisses contain numerous fairly large and coarsely crystalline pegmatite dikes.

"(3). In a region where these pegmatite dikes have not been greatly crushed or sheared in connection with great earth movements, such as accompany the result in the formation of mountains, it will probably be found that these movements have destroyed in large measure the value of the mica.

"(4). Where on some portion of the exposed surface of these dikes occasional blocks of good mica may be observed several inches in diameter, the outlook may be regarded as favorable to development. Of course the size of the blocks exposed on the surface of one of these dikes cannot be taken as a positive indication as to what the size of the blocks will be at any considerable depth below the surface; but as a rule it has been fairly assumed that when along the surface of one of these pegmatite dikes which is exposed for a considerable distance no large blocks of mica are to be observed, none are likely to be found at greater depths.

"(5). When after a limited excavation it is found that practically all or a large proportion of the mica discovered at that point is extensively ruled or generally specked with iron, the probabilities are that these defects will continue in depth, and this will of course greatly diminish the value of the product and consequently the chances of successful mining."

Production.

In 1901 the production of mica was $79,849 of plate mica, and 1,775 tons of scrap mica valued at $14,200. Compared with the production for 1900, which was $65,200 of plate mica and 5,945 tons of scrap mica, valued at $36,262, there is an increase of $14,649 in value of plate mica and a decrease of $22,062 in scrap mica. The approximate value of the production of sheet or plate mica by counties is given in the following table, together with that for 1900:

VALUE OF PRODUCTION OF SHEET MICA IN 1900 AND 1901 BY COUNTIES.

COUNTY.	1900. Value of Plate Mica.	1901. Value of Plate Mica.
Haywood	$ 11,000	$ 11,500
Jackson	7,000	8,740
McDowell	1,000	500
Macon	5,200	----------
Mitchell	26,722	33,506
Stokes	1,000	----------
Transylvania	500	600
Yancey	12,788	25,003
Total value	$ 65,200	$ 79,849

Although so many of the mica mines throughout North Carolina have been closed, it has not been for want of good mica; for many of them were shut down with a quantity of good mica in sight. The reasons for this are that the owners had no capital with which to equip their mines so as to be able to contend with water or to carry on deep mining; nor in many cases were they able to bear the expense of blasting when the harder rock was encountered in depth. Then again, as their mine became a little difficult to work, they would abandon it, and take up another prospect where the mining was easier, and keep on in this way. There are hundreds of small openings that have been made for mica throughout the State and it was this method that led to the term of "ground-hoging" for mica which is often applied to mica mining. There is mica of the best quality and in quantity in North Carolina that will make profitable mining propositions.

QUARTZ.

Quartz, an oxide of silicon, or as it is sometimes commercially called, silica or silex, is one of the commonest minerals and is very widely distributed in nature, being a constituent of many of the crystalline rocks, and the main constituent of all sandstones. It is also found in quantity at widely varying localities, notably as a constituent of pegmatitic dikes. The uses of this mineral are quite varied, it being used in the manufacture of a paste that is used for wood finishing; in the manufacture of pottery and tile; of sand-paper; in certain scouring soaps and powders; in the manufacture of a wood filler, and in glass; and in certain instances it is mined for a flux in copper smelting. Where it is colorless and perfectly transparent it is of considerable value for cutting into spheres, cubes and other forms for ornamental purposes. There are also many varieties of quartz that are of value as gems, see page 51.

There are large deposits of quartz in the mountain counties of North Carolina, some of which should be available for some of the first purposes enumerated above. It would not pay to ship the rough quartz, but by utilizing the available water-power, it does seem as though the ground product could be marketed at a profit. As a by-product in mica mining, its cost of production would simply be in the grinding, and with favorable transportation rates, it should be able to compete with quartz produced in other localities. The completion of the railroad in Yancey and Mitchell counties will make this a more feasible proposition for the quartz deposits of those counties.

The only quartz that has been mined in North Carolina during 1901 was in Cherokee county and was used for flux in the copper smelter at Ducktown, Tenn. This amounted to 3,000 tons valued at $7,500. During 1902 this production will undoubtedly be very materially increased.

FELDSPAR.

Inquiries have been received regarding the occurrence of feldspar in North Carolina, that would be suitable to grind and use in the manufacture of pottery. There are two classes of feldspar that can be used for this purpose, the potash and soda feldspars. Of these the potash is the more valuable and more in demand. Orthoclase and microline, the two potash feldspars, have the following theoretical composition:

	PER CENT.
Silica, SiO_2	64.7
Alumina, Al_2O_3	18.4
Potash, K_2O	16.9

There is nearly always a little soda (Na_2O) that replaces a portion of the potash.

The common soda feldspar is albite, which has the following theoretical composition:

	PER CENT.
Silica, SiO_2	68.7
Alumina, Al_2O_3	19.5
Soda, Na_2O	11.8

In this case there is more or less of the soda replaced by potash. Lime, CaO, is often found in small quantity in the soda feldspars and as this begins to predominate there is a transition to the pure lime feldspar, anorthite.

Feldspar is a common mineral in North Carolina as a constituent of all granites and gneisses and of pegmatitic dikes. A great deal of it, however, found near the surface especially in the southern counties has been either partially or wholly kaolinized, so that it is not of value as a feldspar for pottery manufacture; but in many cases has formed extensive beds of kaolin. In the northern counties, however, fresh unaltered feldspar occurs in quantity. These are found for the most part as constituents of pegmatitic dikes that are being worked for mica, and its production would be in many cases a by-product of mica mining. In the table below are given the localities and percentages of potash, soda and lime of a number of feldspars.

NORTH CAROLINA FELDSPARS.

	PER CENT.				
	POTASH. (K_2O)	SODA. (Na_2O)	ALUMINA. (Al_2O_3)	LIME. (CaO)	SILICA. (SiO_2)
1	11.66	5.95	18.34	.08	64.25
2	9.50	3.62	21.20	Trace.	63.52
3	8.73	6.65	20.20	Trace.	63.55
4	8.39	7.64	19.66	Trace.	62.95
5	7.55	7.85	19.24	Trace.	64.75
6	7.28	7.00	19.04	.12	65.15
7	3.94	7.91	22.26	1.41	64.55
8	2.91	10.04	19.90	None.	64.85
9	.04	8.35	21.60	.64	65.18

1. Young mine, Dobag, Yancey county.
2. Irby mine, near Spruce Pine, Mitchell county.
3. Ray mine, near Burnsville, Yancey county.
4. Averys Meadow mine, Plumtree, Mitchell county.
5. Tolly Bend mine, near Micaville, Yancey county.
6. Flat Rock mine, Flat Rock, Mitchell county.
7. Charlie Robertson mine, near Micaville, Yancey county.
8. Wiseman mine, near Spruce Pine, Mitchell county.
9. Cloudland mine, near Bakersville, Mitchell county.

With the water-powers that are available in the vicinity of where these feldspar deposits occur, which could be utilized for grinding them, and with the construction of the railroad across these counties, connecting with the Ohio River railroads, the ground feldspar should be able to be landed at the potteries in competition with that from other localities.

When it is considered that there are to be found in North Carolina as fine beds of clays as can be obtained; that the other constituents necessary for pottery manufacture are also at hand; and that manufacturing can be carried on as cheaply if not more so than in the Northern States, the question arises why should not pottery industries themselves be established in North Carolina, instead of shipping out the raw materials necessary to maintain these elsewhere.

GEM MINERALS.

There are many of the gem minerals found in North Carolina, and deposits of some have been found in sufficient quantity to become regular producers. There has been but little systematic search for these minerals, but accidental discoveries have been made in various places that have in some cases led to the opening of good deposits of gem material, and there are now a number of companies who are mining in the State exclusively for gems. The principal gem localities are in Macon, Yancey, Mitchell, McDowell, Burke, Alexander and Iredell counties.

The minerals that are classified as gem minerals can be brought under three groups; one consisting of those that are capable of being cut into gems for jewelry, as diamond, ruby, etc.; another consisting

North Carolina
State Library.

of those that are cut into spheres, cubes and other forms, or are carved, and which are used for ornamental purposes, as quartz, serpentine and jade; and third, those that make handsome mineral specimens, as rhodochrosite, pyrite, etc. In the following list are given the minerals that come under some one of the above groups that are known to occur in the United States, and those that have already been found in North Carolina are marked with an asterisk.

LIST OF GEMS AND GEM MINERALS OCCURRING IN THE UNITED STATES.*

- Diamond.*
- Corundum, oriental ruby.*
    - oriental sapphire.*
    - oriental emerald.*
    - asteriated sapphire.*
    - oriental amethyst.*
    - oriental topaz.*
- Topaz.
- Beryl, acquamarine.*
    - emerald.*
    - golden.*
    - blue.*
    - emerald matrix.*
- Garnet, almandine (precious).*
    - essonite (cinnamon).*
    - pyrope (Bohemian).*
    - rhodolite.*
    - spessartite.*
    - schorlomite (titaniferous).
    - topazolite.
    - uvarovite.
- Tourmaline, achroite.
    - Brazilian emerald.
    - indicolite.
    - rubellite.
- Quartz, rock crystal, "pebble."*
    - amethyst.*
    - citrine.*
    - smoky quartz.*
    - cairngorm stone (Scotch topaz).*
    - Spanish topas.*
    - morion.*
    - plasma, prase.*
    - rose quartz.*
    - asteriated quartz, "star quartz."
    - aventurine.*
    - quartz, cat's eye.
    - gold-quartz.*
    - tourmalinated quartz.*
    - hornblende in quartz.*
    - gothite in quartz, onegite.
    - rutilated quartz, sagenite.*
    - fleeches d'amour.
    - Thetis hairstone.*
    - agate.*
    - carnelian.*
    - chalcedony.*
    - chrysoprase.*
    - hydrolite.
    - moss-agate, mocha stone.*
    - onyx.
    - rainbow agate.
    - royal agate.
    - sard.
    - jasper.*
    - bloodstone (heliotrope).
    - jasper, agate.*
    - Lydian stone (basante, touchstone).
    - novaculite.*
    - silicified wood.
    - agatized wood.
    - jasperized wood.
- Opal, opal agate.
    - fire opal.
    - lechosos (milky opal).

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*This list has been made up from one used by Mr. George F. Kunz, of the U. S. Geological Survey.

  - moss opal.
  - noble (precious).
  - sun opal.
  - opaline, opal matrix.
  - hyalite.*
  - hydrophane.
  - wood opal.
  - opalized wood.
- Feldspar, labradorite.*
  - microcline (amazon-stone).*
  - oligoclase (sunstone).*
  - orthoclase (moonstone).*
  - obsidian (volcanic glass).
  - marekanite (mountain mahogany).
  - moldavite.
- Bronzite.*
- Pyroxene (diopside).*
- Hypersthene.*
- Spodumene, hiddenite.*
- Nephrite.
- Pectolite.
- Rhodinite.
- Crocidolite.
- Iolite (cordierite).*
- Sodalite.
- Lazurite (lapis lazuli).
- Olivine (chrysolite, peridot).*
- Phenacite.
- Scapolite (wilsonite).
- Willemite (troostite).
- Zircon.*
- Cyanite (blue and green).*
- Andalusite (macle, chiastolite).
- Zoisite (thulite).*
- Epidote.*
- Chlorastrolite.
- Prehnite (zonochlorite).
- Thomsonite (mesolite).
- Chondrodite.
- Dumortierite in quartz.
- Serpentine.*
- Agalmatolite (figure stone).
- Catlinite (pipestone).
- Chrysocolla.
- Titanite (sphene).*
- Pyrite.*
- Hematite.*
- Rutile.*
  - nigrine.
- Diaspore.
- Prosonite.
- Malachite.
- Azurite.
- Rhodocrosite.
- Turquoise.
  - turquoise matrix,
  - odontolite (bone turquoise).
- Variscite.
  - utahlite.
- Amber.
- Fire marble (lumachelle).
- Fossil coral.

With more systematic search for these minerals, others will be found in North Carolina and some of those already known will be found in greater abundance.

DIAMOND.

In North Carolina diamonds have been repeatedly found; and there are now ten authentic ones whose occurrences are fully established. Besides these, three others have been reported. They have been distributed over a wide area in the counties of McDowell, Burke, Rutherford, Lincoln, Mecklenburg and Franklin. With the exception of Franklin, all of these counties are in the eastern drainage basin of the Blue Ridge. Two have been found on Brindletown creek, Burke county; one at the Twitty mine in Rutherford county; one near Cottage Home, Lincoln county; two on Todd Branch, Mecklenburg county; three from Muddy creek, McDowell county; and one from the Portis mine, Franklin county. Besides these, one is reported from Richmond county, and another from Rutherford county. The largest diamond, weighing 4 1-3 carats, was found in 1886 on the farm of Albert Bright in Dysartville.

Corundum Gems, Ruby and Sapphire.

There is no State or country that excels North Carolina in its variety of corundum gems. They are found red, ruby-red, sapphire-blue, dark blue, various shades of green, violet and purplish, rose, pink, brown, yellow, gray and colorless. The corundum gems are determined by the color and there are, at the present time, nine varieties that are commonly recognized by the lapidaries. In the arts these are usually prefixed by the word "oriental" to distinguish them from other gems of the same name, but whose mineral composition and character are entirely different. These varieties are as follows:

LIST OF CORUNDUM GEMS.

Oriental or true ruby	Red of various shades.
Oriental Sapphire	Blue of various shades.
Pink Sapphire	Rose or Pink.
White Sapphire. Diamond spar.	Colorless.
Opaline. Girasol. Hyaline.	Pale blue or bluish white.
Oriental Amethyst	Purple.
Oriental Emerald	Green.
Oriental Topaz	Yellow.
Star Sapphire. Chattayant. Asteria.	Opalescent.

The locality that has furnished the greatest variety of these gems is the Corundum Hill mine, at Cullasaja, Macon county. Sapphires have also been found at the Grimshawe mine, Montvale, Transylvania county, and at Sapphire, Jackson county.

The North Carolina locality which has attracted considerable attention for the occurrence of corundum gems is a tract of land in Macon county, between the Caler fork of the Cowee creek and Mason Branch, two tributaries of the Little Tennessee river. Ruby corundum of exquisite color and transparency has been found in the gravel deposits of the Caler fork of Cowee creek. Although but a very small percentage of the corundum found in the gravel was transparent, nearly all was of the ruby color. Beautiful rubies of a rich pigeon blood red color have been found here, that could not be told from the Burmah stones. The best stone that has thus far been found is valued at $1,500. Many smaller gems have been obtained that were perfectly transparent and of good color. Sapphires to the value of about $45 were obtained in 1901.

RHODOLITE.

Associated with these rubies is the gem rhodolite, one of the garnet group. It has a variety of shades of color, which for the most part are similar to the delicate rose-like tint of the rhododendron. Then again, its remarkable brilliancy vies with that of the diamond. Most of the varieties of garnet are only beautiful by transmitted light and otherwise exhibit dark shades of color, but rhodolite gives most striking effects of beautiful and varied coloring by reflected light. When first discovered the rhodolite was mistaken by many jewelers for a variety of ruby, and not until they had tested it would they believe otherwise. The rhodolite has only been found in North Carolina, and in a very limited area, which includes the gravels of the streams that rise on Mason mountain, Macon county. The largest rhodolite found in 1901 weighed 43½ carats. The value of these gems found in 1901 was $20,350.

GARNET GEMS.

Beside the rhodolite referred to above, the almandite and pyrope varieties of garnet have been found extensively in many sections of the State. Good gems of these varieties have been found in Macon, Alexander, Yancey, Mitchell, McDowell, Burke, Caldwell, Catawba and Lincoln counties, but the best colored and most transparent ones have been obtained from the first two counties. At many of the mica mines, transparent garnet crystals are found, flattened out between the foliæ of the mica. Otherwise than as gem minerals garnet is widely distributed in the State, and is a constant constituent of many of the micaceous and other igneous rocks, and as stated on page 36, occurs at times in sufficient quantity to be of value for abrasive purposes. The value of these garnets obtained in 1901 was $625.

BERYL.

This is a mineral that varies in color from emerald green, pale green and sea green to yellow, light blue, and white. The emerald green color is due to the presence of a little chromium and that variety is highly prized as a gem when clear and free from flaws. The beryl emerald is the one that is commonly sold at the present time, the oriental or true emerald (the green variety of sapphire) being one of the rarest of the gem stones. North Carolina has furnished some very handsome beryls of emerald green color, some of which have been cut into fine stones. The most noted locality is near Hiddenite, Alexander county, North Carolina. The first emeralds that were obtained in this locality were found in the soil and it was not until 1881 when the Emerald and Hiddenite Mining Company was organized that any direct mining was undertaken. As the deposits were followed downward through the soil, the unaltered rock was encountered and, as the work was extended into this, their exact occurrence was seen. They occur in pockets of quartz associated with rutile, hiddenite, quartz, muscovite, dolomite, pyrite, garnets, etc., all of which are well crystallized. The rutile found here is the finest that has been observed in any locality in the world. It is a mineral of a nearly black color by reflected light, but a deep red in thin splinters by transmitted light and is often used for cutting into stones for seal rings as a substitute for the black diamond which it somewhat resembles when cut. The quartz associated with the emeralds is exceptionally well crystallized and has furnished some of the most modified crystals ever found.

The largest emerald crystal found here was a very perfect specimen of a fine but somewhat light green color, which was doubly terminated and weighed 8¾ ounces. One of the largest stones cut weighed $4\frac{2}{3}\frac{3}{2}$ carats and was of a somewhat light green color.

On Crabtree mountain, between Brush and Crabtree creeks, Mitchell county, emerald beryl occurs in a pegmatitic vein. No very large crystals have as yet been found at this locality, but some have been taken out that have cut small gems of a deep emerald color. Matrix specimens of emerald with feldspar, tourmaline or quartz are being cut en cabachon and they make handsome and attractive stones.

The aquamarine variety of beryl is found very commonly in many of the pegmatitic dikes that have been worked for mica. The most important of these are in the vicinity of Spruce Pine, Mitchell county, at the Ray mine, Yancey county, and the Littlefield mine, Macon county, where transparent aquamarine beryls have been found very abundantly that have cut many beautiful gems. Beside the aquamarine, blue beryl has been found in fine crystals in the mines near Spruce Pine, Mitchell county, so also has the yellow or golden beryl. The Wiseman property near Spruce Pine, Mitchell county, is a promising field for aquamarines and has furnished pieces up to 20 carats in weight. The value of the beryls of all varieties mined during 1901 was $2,250. Of the beryls found during 1901, the largest aquamarine weighed, when cut, 11 carats, the largest blue beryl, 26 carats, and the largest yellow or golden beryl, 6 carats.

HIDDENITE.

This gem is a variety of the mineral spodumene, a lithium aluminium silicate, and is of a yellowish-green color, due probably to the presence of minute quantities of chromium. Hiddenite has only been found at the emerald locality at Hiddenite, Alexander county. While some of the crystals have a uniform green color, they are generally yellow at one end and graduate through yellowish-green to a green at the other. The hardness of the hiddenite is below that of quartz, being but 6.5 to 7, but on account of its rarity, color, and very brilliant lustre, it ranks at the present time as one of the most expensive gems. The finest crystal that was obtained from this locality measured 2 3-5 inches by ½ inch by ¾ inch, with one end of a very fine green color and would probably afford a gem, if cut, which would weigh about $5\frac{1}{2}$ carats.

QUARTZ.

This mineral is very varied in its occurrence and is found in many colors and forms, furnishing many varieties of gems. The more important of these gem varieties are given below:

Rock crystal has been found in many beautiful transparent crystals and masses from White Plains, Surry county; Hiddenite, Alexander county, and Chestnut Hill, Ashe county.

Smoky quartz or Cairngorn stone is found in quantity in Burke and Alexander counties.

Amethysts of a beautiful deep purple color have been found at a number of localities in the State, principally in Macon, Lincoln and Catawba counties.

Sagenite or Venus Hairstone is crystalline quartz that is penetrated with a net-work of acicular crystals of rutile. Some of the most beautiful specimens of this rutilated quartz have been found in Alexander and Iredell counties. It has also been found in Catawba, Burke and Randolph counties.

Citrine or Spanish topaz is a yellow variety of quartz that has been found in Burke and adjoining counties, but seldom of a rich deep color.

Other quartz gems that have been found in North Carolina are chrysoprase, from Macon county; rose quartz, and morien, from Alexander county; aventurine from Iredell county; chalcedony; agate; jasper; and carnelian. The value of the quartz gems found during 1901 was about $355.

OTHER GEM MINERALS.

The feldspar that is a constituent of the pegmatitic dikes of Mitchell and Yancey counties, is occasionally met with of good quality for cutting into moonstones and sunstones.

Beautiful crystals of rutile are obtained from Alexander county that have been cut into gems that resemble black diamonds.

Fine blue crystals of cyanite are obtained in Mitchell and Gaston counties. Near Spruce Pine, Mitchell county, some of the finest grass-green cyanite that is known has been discovered.

Staurolite, zircon, spinel, peridot, lazulite, and serpentine are among the other gem minerals that have been obtained in the State.

The total value of gem minerals produced in 1901 was $24,245 as compared with $12,020 in 1900. This production was divided as follows:

PRODUCTION OF GEM MINERALS IN 1901.

NAME.	VALUE.
Rhodolite	$ 20,350
Other garnets	625
Beryls	2,250
Sapphires	45
Quartz gems	355
Other gems	20
Mineral specimens	600
Total value	$ 24,245

MONAZITE.*

Monazite, which is essentially an anhydrous phosphate of the rare earth metals cerium, lanthanum and didymium, usually contains a varying but small percentage of thoria and silicic acid, which are very probably united in the form of a thorium silicate. It is the presence of this thoria that gives the monazite its commercial value, and this varies from a fraction of a per cent. to 32 per cent., but the majority of the monazite samples contain from 3 to 9 per cent. of this oxide. The mineral is a light yellow to honey yellow, reddish, brownish, or greenish-yellow in color, with a resinous to vitreous luster, and is brittle, breaking with a conchoidal to uneven fracture. Its hardness is from 5 to 5.5 (being readily scratched by feldspar) and has a specific gravity of 4.64 to 5.3.

OCCURRENCE.

Monazite is found very widely distributed as an accessory constituent in varying proportion in many granites and their derived gneisses; but the commercial deposits have thus far not been found in the original rocks, as they contain but a fraction of a per cent. of this mineral, but are found in the placers of the present streams and rivers and in the old sands and gravel deposits of former streams. By the decomposition and disintegration of these crystalline rocks, which in the Southern States has proceeded to considerable depths, and by erosion, the constituents of these rocks are deposited in the stream beds, the heavier minerals being deposited first and nearer where they originated, and thus the richer deposits of monazite in these placer gravels or sands are found nearer the source of the original rocks. Monazite has been found in the granitic mica gneisses and hornblende gneisses of the South Mountain Region of North Carolina, covering an area of some 2,000 square miles in McDowell, Burke, Rutherford, Cleveland, Polk, Catawba, Lincoln and Gaston counties, and from the alteration and erosion of these rocks have been formed the extensive deposits of these counties which have been the chief sources of all the monazite mined in the United States. These workable deposits are found along the streams that have their sources in the South mountains, and they are Silver, South Muddy, and North Muddy creeks and Henry and Jacobs forks of the Catawba river, in McDowell and Burke counties; the Second Broad river and tributaries in McDowell and Rutherford counties; and the First Broad river and tributaries in Rutherford and Cleveland counties. In recovering the monazite, the sands and gravels are sluiced similarly as placer gold is washed, and, after drying the resulting concentrates, the magnetite, ilmenite, etc., are separated by means of the electro-magnet. As the value of the sand depends upon the percentage of thoria, and as this is dependent in turn upon the percentage of monazite in the sand, it is to the producer's advantage to make his sand as nearly pure monazite as possible. One company is erecting a mill near Shelby, Cleveland county, North Carolina, to treat the saprolitic rock containing the monazite, claiming that they can get a purer product than from the placer deposits. From the experiments that they have made, they believe that they can work these decomposed gneisses at a profit.

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*See also Bulletin No. 9.

There are given below the percentages of Thoria (ThO_2) that have been found in some of the commercial monazite sands of North Carolina:

PERCENAGE OF THORIA (ThO_2) IN NORTH CAROLINA MONAZITE SAND.

	PER CENT.									
	1	2	3	4	5	6	7	8	9	10
ThO_2	2.18	2.25	6.54	1.27	6.30	2.48	5.87	6.26	3.98	1.93

1. White Bank Gold mine, Burke county.
2. Hall Creek, Burke county.
3. Linebacher Place, Silver Creek, Burke county.
4. Long Branch, McDowell county.
5. Alexander Branch, McDowell county.
6. MacLawrath Branch, McDowell county.
7. Proctor Farm, near Bellwood, Cleveland county.
8. Wade McCurd Farm, Carpenters Knob, Cleveland county.
9. Davis Mine, near Mooresboro, Cleveland county.
10. Henrietta, Rutherford county.

The monazite concentrates obtained from working the saprolitic gneisses is said to contain 7.01 per cent. of thoria. Sand is reported to have been obtained in Burke county that contains 7.28 per cent. of thoria.

As is seen from the above, there is a wide variation in the percentage of thoria in the commercial monazite sands. This percentage can be, in many cases, very materially raised, by more careful washing of the gravels, and using the electro-magnet in the separation of the iron minerals. In some instances the monazite deposits contain more or less gold, so that they can be worked for this metal, leaving the monazite as a valuable by-product.

The thoria contents of the monazite is used in the manufacture of the cylindrical hood or mantle of the Welsbach and other incandescent gas lights. The cerium oxalate, obtained in the separation of the rare earth oxides, is used in pharmacy. There are also very small quantities of lanthanum and didymium oxides used with the thoria in the manufacture of the cylindrical mantles.

There was a considerable increase in the value of the monazite produced in 1901 over that of 1900, although the amount was less, and was 748,736 pounds valued at $59,262 as compared with 908,000 pounds valued at $48,805 in 1900. While this increase in the value per pound of the monazite is partially due to an increase in the price of the sand, it is also partly due to the fact that the production reported is cleaner sand and, therefore, higher in thoria. The actual amount of thoria produced in 1901 is probably fully as much, if not more, than that produced in 1900. The price of monazite received by the original miner varies from 3½ to 5 cents per pound, but the further cleaning to which the material is subjected, increased its value to 8 cents per pound. The larger amount of the monazite was obtained from Burke and Cleveland counties with smaller amounts from McDowell and Rutherford. There is a considerable demand for North Carolina monazite both in this country and abroad, and during the past few months (December, 1901, to February, 1902) a number of representatives of German manufacturers have been in the monazite districts of North Carolina investigating the field with a view to purchasing deposits. One tract of 353 acres is reported to have been bought near Ellenboro, Cleveland county. It is very probable that the production of 1902 will exceed both in value and amount by a considerable figure that of 1901.

In the following table is shown the production of monazite for the past ten years:

PRODUCTION OF MONAZITE IN NORTH CAROLINA FROM 1893 TO 1901.

	Pounds.	Value.
1893	130,000	$ 7,600
1894	546,855	36,193
1895	1,573,000	137,150
1896	30,000	1,500
1897	44,000	1,980
1898	250,776	13,542
1899	350,000	20,000
1900	908,000	48,805
1901	748,736	59,262

Prior to 1893 there were a few tons per year shipped from different points, but the exact amount is not known. In 1887 the first monazite was shipped from North Carolina, amounting to 24,000 pounds, and was obtained from Brindletown creek, Burke county. By 1893 the monazite industry was well established and continued to increase very rapidly until 1895, when 1,573,000 pounds were produced valued at $137,150. It was at this time that the Brazilian deposits began to be worked and it at once affected the production in the United States, which dropped to 30,000 pounds. In 1898 the industry began to revive and has gained steadily each year, until once more it seems to be firmly established.

BARYTES.

The mineral barytes does not usually occur in well defined veins except when an accessory mineral in certain metallic veins; but is more often found in a series of pockets, lenses, or seams of varying dimensions. These are more or less in line often following the dip of the rock with which they are associated and this rock is in many cases a limestone. Barite is a heavy white mineral with a perfect prismatic cleavage and is known commercially as barytes. In chemical composition it is a barium sulphate ($BaSO_4$).

The larger proportion of the barytes mined in North Carolina is sold in the crude state direct to the manufacturers, and but a small part is subjected to any treatment before being sold, beyond the washing off of the attached dirt and soil. In preparing the barytes for use, it is cleaned, crushed and some is bolted and some floated. This flour barytes is used in the manufacture of paper, rubber, paints, and in the preparation of a material that is used to coat canvas sacks in which hams are sold. Only the first grades are used in the manufacture of paints, by mixing with white lead, and it is known as "floated barytes." Where it is too much stained with iron oxide to be available for the above purpose, it is beginning to be used in the manufacture of various barium salts. Experiments are also being made as to its value in the glass industry; but no definite results have thus far been obtained.

The barytes deposits of North Carolina that have been worked the most extensively during 1901 are in Madison county in the vicinity of Marshall, Stackhouse, and Sandy Bottom and Hot Springs. It occurs in small seams and elongated pockets, varying from 3 to 10 feet in width and is very free from impurities. About 3½ miles southeast of Hillsboro, Orange county, near the Chapel Hill road, this mineral of good quality has been found and is very probably in quantity. This property is now being developed by Mr. T. G. Fry of Goldsboro, N. C. The production of barytes in North Carolina in 1901 was all confined to Madison and Gaston counties and amounted to 7,390 tons valued at $22,615. There have been many inquiries received during the past year regarding localities where this mineral occurs. This has led to the development of the deposit near Hillsboro, and it is very probable that there will be a considerable increase of the production of this mineral in 1902 over that of 1901.

At the Stackhouse mine, what appeared to be two veins at the surface have with depth come together, making a total width of barytes of over 9 feet. Outcroppings of barytes have been observed on the surface for a distance of 2,200 feet. It is expected that the output of this mine will be largely increased during 1902.

The barytes mined by the Carolina Mineral Company is cleaned and ground at their mill at Marshall, and is the only barytes mined in North Carolina that is thus treated. There are one or two individual operators of barytes in this district, but most of the output is controlled by one company.

Lawson Barytes Mine, near Bessemer City, N. C.—The barytes deposit is located about five miles nearly due south from Bessemer City, Gaston county, a station on the Southern Railway, and is about one mile a little east of south of the north end of the peak of Crowder's mountain. The elevation at the mine is somewhat higher than the railroad at Bessemer City and a perfect graded road could readily be built from the mine to the railroad at a point which would be distant about four miles from the mine.

Crowder's mountain, near which the mine is located, is one of a line of isolated peaks and ridges which stretches from the South Carolina line northeastward, the most noted ones of those peaks being Kings, Crowder's and Anderson mountains. These mountains rise from 500 to 1,000 feet above the average elevation. The country rocks of this district are for the most part crystalline schists and gneisses, the former being micaceous, chloritic, argillaceous, and sometimes graphitic; the latter are micaceous. The strike of the schistosity of these rocks is in a general direction northeast, and the dip generally westward at very steep angles. Occasionally lenticular bodies of sileceous, magnesian limestone have been observed, but none were found to the eastward of Crowder's mountain in the vicinity of the barytes deposits, although they have been found to some extent to the westward of this mountain and between it and King's Mountain. Quartzite has been observed as forming the higher ledges of the mountains.

Barytes has been found at a number of points in the vicinity of King's and Crowder's mountain, and occurs in what at first appear to be regular well defined fissure veins between walls of a micaceous, argillaceous schist. The barytes outcrops at intervals and has been encountered by open cuts and pits at numerous points throughout a distance of 2,400 feet. The main deposit, or so-called vein, varies in width, as now exposed in the underground workings, from 2½ to 6 feet and at one point it was observed 12 feet in width. As the deposit was followed down from the surface, it was found to widen from a few inches to a foot to the width mentioned above. To the west of this main deposit there is another, approximately parallel, which, however, is not as wide. There are also small seams of barytes that were observed directly east and west of this main vein and separated from it by narrow bands of schist. About 400 feet to the east another vein that is approximately parallel to the first has been encountered. The strike of the barytes veins is in general approximately north 10° to 15° east and dipping at high angles, usually toward the west. In some places they are nearly perpendicular. As will be noticed, the strike and dip of the barytes correspond closely to the strike and dip of the schistosity of the schist. Where the barytes was encountered near the surface and followed downward, it increased in width; but there was considerable variation in the width as followed along the strike; in two or three instances, where it has been followed along the strike, the barytes narrowed down to a thin seam. At lower levels, however, following the same direction and at a corresponding point on the strike, the barytes was found to be much wider. This, with the other phenomena noted, would indicate that the barytes is occurring in lenticular masses whose strike and dip are conforming to those of the schist and are pitching toward the south. One of these lenses is at least 400 feet in length, as it has been opened up for this distance by means of drifts; but it is undoubtedly considerably longer.

The barytes very probably represents the filling of fissures and crevices in the schist which may have been caused by the faulting and the tearing apart of the schist. This method of formation of these deposits of barytes would readily account for the finding of the large main veins of barytes and the smaller seams approximately parallel to them. These lenticular veins may be found to be many hundreds of feet in depth and then be connected by a thin seam of barytes with another. Judging from the length of the barytes lenses already observed, it may be expected that they will be followed for a number of hundred feet before they begin to pinch out.

Where the barytes is more or less cracked and seamed, it is badly stained with iron oxide, but with deeper mining this began to grow less. There are some sulphides found associated with the barytes such as galena, and sphalerite; but as far as observed, these have been along certain lines and not scattered through the barytes. In breaking up the masses of barytes which contain these streaks of sulphides, it readily breaks, following these seams, and the sulphides can as a rule be readily eliminated by hand-cobbing with but very little waste of the barytes. By giving a little care to the hand-cobbing of the barytes, by far the larger proportion of the iron-stained barytes, which is due to seams and cracks, can be eliminated. Most of the barytes is free from grit, especially in the wider portions of the deposit, but occasionally along the contact or in the narrower portions, some barytes was encountered that contains grit; but this can readily be kept separated from the first quality of barytes.

It is usually granular in structure, but occasionally masses of some size are obtained that are made up of cleavable blocks. The quality of the barytes, as a whole, is good and by giving some care to its selection, barytes of the first quality can be obtained.

OCHER.

In Henderson county, about $4\frac{1}{2}$ miles southwest of Saluda and one fourth of a mile from the Polk county line, on land belonging to M. M. Staton, there is an ocherous clay that occurs in quantity. This has been used as a paint pigment and is said to give satisfaction. Saluda, on the Southern Railroad, is the nearest point on the railroad and is connected by a good road.

In the vicinity of Tomotla, Cherokee county, ocher has been found to some extent, but sufficiently large deposits have not as yet been discovered that would justify the erection of a plant for preparing it for market. In the vicinity of Wilson's Mills, Johnston county, on the land of Mr. W. G. Wilson, ocher deposits of some promise have been discovered. Mr. C. H. Womble of Glendon, Moore county, has reported the occurrence of yellow ocher near that place, where it is believed to occur in quantity.

Near Rockingham, Richmond county, on land belonging to Mr. Steele, red and yellow ocher of good quality has been found. They make a good pigment, and the property is worthy of further investigation.

TALC AND PYROPHYLLITE.

The demand for talc and the similar mineral pyrophyllite is constantly increasing and this is causing a considerable interest to be centered in the North Carolina deposits of Swain, Cherokee, Moore, and Chatham counties.

The properties of these minerals, that make them suitable for the purposes for which they are to be used, are their extreme softness (being among the softest minerals known); their purity or freedom from grit; their stability; and their smooth, slippery touch. When the talc is of sufficient compactness, it is sawed into pieces of various shapes and sizes; gas tips; and into different styles of pencils. The larger proportion of the talc and pyrophyllite which are mined is ground to a flour, similarly as mica, and used in the manufacture of talcum powder; in wall paper; as the basis of many lubricants; in paper; and in the manufacture of some of the cheaper varieties of soap.

The impure varieties of the mineral talc, which are known as soapstone, contain more or less grit and are not as a rule suitable for the purposes enumerated above. It is, however, quarried to a large extent for manufacturing into various soapstone articles, as griddles; boot and shoe dryers; table tops for laboratories, ovens, etc. It is also used to some extent for chimneys and for lining fire-places. For this latter purpose it has been quarried in small quantity at a number of places in the mountain sections of the State.

The talc deposits of Swain and Cherokee counties are found in connection with the marble formation of this section of the State. What was formerly supposed to be a regular vein of the talc was probably a series of pockets of this mineral of varying thickness, lying for the most part directly between the marble and the quartzite, although at times they are entirely enclosed by the marble. None, however, have been observed that were enclosed by the quartzite. These pockets, which resemble in shape flattened lenses, always follow the dip of the strata in which they occur, and are therefore encountered in all positions from horizontal to vertical.

The pyrophyllite deposits are located in the extreme north central portions of Moore and the south central part of Chatham counties, and can be traced across the country for a distance of eight miles. The principal mining that has been done is near the boundary between the two counties in the vicinity of Glendon, Moore county. They are associated with the slates of this region but are not in direct contact with them, being usually separated by bands of siliceous and iron breccia, which are probably 100 to 150 feet thick. These bands of breccia contain more or less pyrophyllite, and they merge into strata of pyrophyllite schist. Between these and the massive beds of pure pyrophyllite there are very often small seams of quartz and larger lenticular quartz masses several feet thick.

The beds of this mineral are not entirely of commercial quality, but there are bands of the pyrophyllite that are highly siliceous alongside of those that are entirely free from grit. Although the general appearance of the waste and good material is very similar, they can readily be distinguished by the touch, and can readily be kept separate by hand cobbing.

The more important talc mines in the State are the Hewitt and Nantahala in Swain county and the Hillyer in Cherokee county. Of the pyrophyllite mines, the Snow, Womble, and Rogers creek are the largest and are all in Chatham county.

PRODUCTION.

As these two minerals are used for the same purposes, their production is given together and in 1901 it amounted to 5,819 tons valued at $77,824. This is an increase of 2,319 tons and of $35,824 in value over the production of 1900, which was 3,500 tons valued at $42,000. This large increase is due to the re-opening of the Hillyer mine in Swain county, the Snow mine in Moore county and a general increase in the production of the other mines. Besides that above, there was a small amount of soapstone that was quarried for cutting into slabs for chimneys, etc.

The different forms in which this talc was marketed are shown in the following table:

TALC PRODUCTS OF NORTH CAROLINA IN 1901.

	1901.	
	Tons.	Value.
Ground talc, for powders, etc.	2,864	$ 29,505
Talc cut into pencils, gas tips, etc.	375	26,000
Talc sold crude	2,580	22,319
Soapstone cut into slabs for chimneys, etc.	-----------	150
Total	5,819	$ 77,974

The demand for North Carolina talc is really greater than the supply; and there are other deposits in the talc belt that are worthy of investigation. Notwithstanding the large increase in the production of talc in 1901 over that of 1900, the production of 1902 will probably be still greater.

GRAPHITE.

Graphite commonly occurs in embedded foliated masses and also in granular, compact, and micaceous masses, sometimes as a solid structure and at other times earthy. It is sparingly found in 6-sided and tubular crystals, and this with the foliated variety has a perfect basic cleavage, the thin laminæ that separate being flexible but not elastic. In color it is black to a dark steel gray and has a metallic to sometimes dull and earthy luster and a greasy feel. It varies in hardness from 1 to 2. The chemical composition of graphite is theoretically pure carbon, but it is often impure from the presence of iron sesquioxide, clay, quartz, etc. The properties of graphite that make it specially valuable for the purposes for which it is used in the mechanic arts, are softness, flexibility, low coefficient of friction, conductivity, adhesiveness and exceedingly slow oxidation at high temperatures.

The different grades of graphite are used for different purposes; the best grades, which are practically pure graphite, are used in the manufacture of lead pencils, lubricants and for electrical purposes. The other grades are used in the manufacture of crucibles, stove polish, foundry facings and in the manufacture of paint for metallic surfaces. The largest use of graphite is undoubtedly in the manufacture of crucibles.

The amount of graphite mined in the United States is comparatively small when compared with the amount that is imported. The production of graphite in this country has increased very materially in the past two or three years, but this is also true of the importation, and thus there is a wide opening for graphite mining in this country; and any newly discovered deposit of this mineral that is near the railroad is worthy of investigation. There have been many inquiries regarding the occurrence of graphite in North Carolina by those interested in obtaining deposits of this mineral, and during 1901 considerable attention was given to the investigation of these deposits.

OCCURRENCE.

As a mineral, graphite is widely distributed in nature, occurring in gneisses, mica schists and crystalline limestones, but as an ore deposit, it is found in but few places and occurs in beds and embedded masses and in laminæ or scales in these rocks. Schists have been observed impregnated with graphite to such an extent that they become graphitic schists and have been found extending over a number of miles of territory. Graphite deposits of some considerable promise have been found in Yancey, Mitchell, McDowell, Burke, Catawba, Wilkes and Wake counties. At Graphiteville, McDowell county, an extensive plant is being erected by the Connally Graphite Works to mine and manufacture the graphite that occurs in this section. The deposit consists of an extensive series of bodies of graphitic schists in a country rock of mica schist and gneiss, the schists varying widely in their percentage of graphite. These graphitic schists can be traced for a distance of about 3 to 4 miles in a N. E.-S. W. direction from Brush mountain on the west to Fork mountain on the east. The deposits first became prominent near Mill creek trestle of the Southern Railroad. The schists cross up and down 5 ridges, each of which rise to a height of 500 feet or more above the general level of this section of the country. The aggregate amount of graphite in this deposit is enormous, but it presents certain problems in its purification and the method to be used is one discovered by Dr. J. W. Ihne, who is general manager of the company.

Similar deposits occur in Burke and Wake counties. In the latter county, however, the percentage of graphite is apparently greater, as also the extent of these deposits. These Wake county deposits are found in a belt extending in a N. E.-S. W. direction with about the middle of the belt 2½ miles west of Raleigh. The two more promising properties on this graphite belt belong to the Tucker estate (care of Chas. H. Belvin), Raleigh, North Carolina, and the other to Mr. E. McK. Goodwin, Morganton, North Carolina. The graphite deposit on the former of these properties is first encountered near Method depot on the Southern Railway, and can be traced for 8 or 9 miles toward the northeast, and for two or three miles to the southwest. The best graphite has been found in that portion of the deposit to the north of Method and it has been worked to a limited extent for a number of years. For crucible and foundry purposes this graphite is well adapted. The other property lies just north of the Holly Springs road, about 4 miles from Raleigh and about 2½ miles from Caraleigh Mills, a siding of the Southern Railway.

In Catawba county, graphite deposits 9 miles east and southeast of Newton have been developed to some extent. The principal work was done nearly 30 years ago. Several shafts were sunk and a considerable quantity of graphite was taken out, cleaned and shipped. Deposits in the same vicinity are now being worked by A. P. Lynch and W. R. Selfand of Newton. They have sunk a shaft 20 feet deep on the deposit and report that a better quality of graphite was encountered in the bottom of the shaft than near the surface.

All the graphite occurring in these deposits is of the amorphous variety and will only make what are called the second and third grade ores, but these grades constitute by far the larger proportion of the graphite used.

One of the most interesting graphite deposits in the State is one in Alexander county, about 5 miles from Taylorsville. The properties upon which this graphite has been found are first encountered about 5 miles a little south of west from Taylorsville on the eastern and northeastern slopes of Barretts mountain, and graphite has been observed at intervals for a distance of over two miles in a direction a few degrees west of south.

The country rocks are schists and gneisses, cutting through which are pegmatitic dikes varying from a few inches to five (5) feet or more in thickness. The graphite occurs in these pegmatitic dikes and is in the form of small particles and nodules from a fraction of an inch to six or more inches in diameter. Wherever these pegmatitic dikes have been observed, they have been badly decomposed and but very little fresh feldspar has been observed in them. The graphite is of good quality, some being of a nearly crystalline character. In the deeper workings there was but little of the graphite stained with iron oxide. On breaking open the nodules of this mineral, they were found to be nearly pure, and on testing them, no grit was observed. The quality of the graphite seems to be uniform wherever encountered along this belt, although, of course, some variation was noted in the percentage of that stained with iron oxide, according as it was found near the surface, or at considerable distance below. There is considerable variation in the percentage of graphite in these pegmatitic dikes, and it will not average over 25 per cent. In some places, however, where the large nodules of graphite were found, the percentage will run as high as 50 or 60 per cent. The graphite is readily separated from these decomposed dikes, and where it occurs in nodules of an inch or over in size, a product can be obtained by hand-cobbing that is composed of 90 per cent. or over of graphite. No work has been done of sufficient depth so that the unaltered pegmatitic dikes were observed, but in one opening the dikes were observed that were but partially decomposed. If in depth the graphite remains a constant constituent of these pegmatitic dikes, it should be found in a very pure condition as the solid dike is encountered and it should not be a difficult problem at all to make a clean separation of the graphite from the associated minerals of the dike. These pegmatitic dikes are dipping from 30 to 50 degrees northwest and have a general strike a few degrees east of north. They follow for the most part the lamination of the rocks, but sometimes are cutting across them. They vary considerably with width, widening and contracting in short distances.

The occurrence of graphite in pegmatitic dikes is unusual, although it is often found in gneisses and schists, in some places being so abundant in the schist as to form those that are termed graphitic-schists. At only one point was any of the country schist observed that contained any appreciable per cent. of graphite. This was at a small opening on the Will Bentley farm.

The National Graphite Company of Chicago, Ill., are developing a property in Yancey county, but have not as yet done sufficient work to demonstrate what their property contains.

The only graphite mined during 1901 was from the Wake county deposits and amounted to 95 tons valued at $559.25.

COAL.

The coal deposits of North Carolina are confined to the two narrow areas or belts of Triassic sandstone and shales, which cross obliquely the Piedmont Plateau region and are in general parallel to the mountains and seashore. The larger of these is known as the Deep river belt, which in a general way extends along a trough from Oxford in Granville county, southwestward across the State with a width near its central point of some 15 miles, but narrowing very considerably at each end. The coal of the Deep river belt is limited to a region extending from the southern part of Chatham county 10 or 12 miles into the northern part of Moore county. There are five seams of coal reported in this belt which are separated by black shales and slates, black-band iron ore and fire clay. These seams of coal vary from 6 inches to 4 feet in thickness, but with a probable workable average of 22 to 24 inches. While this cannot be called an extensive coal field, it does offer possibilities of remunerative coal mining. The principal mines being operated are the Cumnock by the Chatham Coal and Coke Company located at Cumnock, Chatham county.

The Dan river belt, which has a width of from 2 to 4 miles and a length of nearly 30 miles in a N. W.-S. E. direction, extending across Stokes and Randolph counties, does not offer as promising possibilities for coal mining as the Deep river belt. The most promising outcrops for coal are those along the line near the wagon road from Walnut Cove to Germanton, Stokes county. The coal-bearing seam at this point is said to have a thickness of from 2 to 7 feet.

The most serious obstacles in mining these coal deposits are the narrowing and pinching of the coal to thin seams; the variation in quality, the wider beds being very apt to be more slaty; the intersection of the coal beds by trap dikes; and the absence of coal from some portions of the area. For these reasons no large prices have been paid for coal lands in this district; and mining should not be undertaken on any considerable scale until the property has been thoroughly tested by boring. The coal is a bituminous of good quality. For all the coal mined in this district, a local State market can be obtained, and the coal should bring a fair price, if it is kept free from slaty material, for the coal has a good reputation. When undertaken conservatively, the mining of this coal should make a profitable but small investment.

The Cumnock mines of the Chatham Coal and Coke Company at Cumnock continue to be the largest producers of coal. A new property of 625 acres is being developed by E. D. Steele of High Point, North Carolina. It is located one mile from Hora Branch, a station on the Durham and Charlotte Railroad in a horse-shoe bend of Deep river, Moore county. The property has been tested by borings and pits. One hole made 1/4 of a mile from the northeast boundary of the property showed the presence of two coal seams, the upper 1 foot 9 inches in thickness, then a seam of slate, and the lower seam 2 feet 8 inches in thickness. Two other holes about ½ a mile southwest of the first showed about the same results. About one-fourth of a mile northwest of the first, another hole was bored which showed 3 feet of soil; 6 feet 10 inches of saprolitic rock; 3 feet of a fire clay; 4 feet 4 inches of slate; and 2 feet 10 inches of good coal. Another property near Eagle Springs, Moore county, is being developed. Samples of coal from this locality were of good quality.

The production of coal in 1901 was 3,723 tons valued at $5,585 as compared with 18,000 tons valued at $22,500 in 1900. The value given for the coal is that obtained for it at the mine. If the work is continued on the Moore county deposits the output should be increased during 1902.

BUILDING STONES.

North Carolina is exceptionally well provided with building stones, which are to be found in abundance in the middle and western counties, and include sandstone, granite, marble, limestone, slate and serpentine, which are taken up in the above order.

Sandstone.

Sandstones are found in the Triassic sandstone formation that forms one belt of rock in Anson, Moore, Chatham, Wake, Durham and Orange counties, and another in Stokes and Rockingham. Dr. Geo. P. Merrill, connected with the United States National Museum, in speaking of the rocks in this belt says: "The narrow belt of Triassic sandstone already mentioned as passing through this State furnishes fine, compact, light and dark reddish-brown stone of a quality not at all inferior to any of that in the more northern and eastern States." The principal points at which brownstone or sandstone is being quarried are Sanford and Carthage in Moore county; Cumnock, Chatham county; and near Durham, Durham county.

In the western part of Wake county there is good desirable sandstone that is accessible to the railroad. In Anson, in the vicinity of Wadesboro, there are a number of good deposits of sandstone, as at the Frank Hammond, Linehan and Wadesboro quarries. The stone from all these quarries is homogeneous, fine grained and quite compact, and usually of a reddish-brown color, varying in places from gray to a grayish-brown. Compression tests made on a block of this stone from Wadesboro cracked at 8,000 pounds per square inch, and was crushed at 11,168 pounds. Its chemical composition is as follows:

	PER CENT.
Silica (SiO_2)	69.28
Alumina (Al_2O_3) and Iron Oxides (Fe_2O_3 and FeO)	13.84
Magnesia (MgO)	.02
Potash (K_2O) and Soda (Na_2O)	6.43

One noticeable feature of this stone, which is characteristic of most of the stone throughout the belt, is that it hardens considerably on exposure. While it works quite easily when freshly quarried, being split, dressed, and carved with ease, on being exposed for sometime to the air and sun it hardens and becomes very refractory. This is perhaps due to material held in solution (as lime) by the "quarry water," which acts as a cementing material upon the evaporation of the water.

Moore county has a number of localities where a good quality of sandstone can be obtained; one is about one mile northwest and another one mile southwest of Sanford. The McNeill quarry is about three-fourths of a mile from the court-house at Carthage, and contains a good brownstone deposit that can be easily quarried. During 1901 only a few corner stones and steps were quarried on account of the lack of capital to properly equip the quarry and introduce the stone on the market. The quarries of R. E. Carrington & Co. of Sanford are the ones that have been the most extensively operated during 1901. They produce a good building stone that wears well, and has the following chemical composition:

	PER CENT.
Moisture (H_2O)	0.79
Silica (SiO_2)	81.59
Ferric Oxide (Fe_2O_3)	4.38
Alumina (Al_2O_3)	10.81
Lime (CaO)	1.02
Magnesia (MgO)	.33
Potash (K_2O) and Soda (Na_2O)	1.08

The sandstone deposits of Chatham county are in the vicinity of Gulf and Cumnock (Egypt) and there are a number of localities that offer favorable opportunities for quarrying. Near the village of Egypt there is a bluff rising about 30 feet above Deep river that extends at about the same height for half a mile down the river. The color of the stone is a uniform brownish-red, and it is fine-grained and compact. At Gulf there is a fine-grained red-brown sandstone in a bluff that rises about 25 feet above the river.

The sandstone deposits of Durham county are a few miles north and east of the city of Durham. There are also good deposits in the vicinity of Brassfield in the southwestern corner of the county.

Although at the present time there is but little quarrying being done on the sandstone deposits, it is not because they are not extensive or well adapted for building purposes, but for lack of capital. They are capable of being developed on an extensive scale and when the stone is once introduced into the general market it will give satisfaction and there will be considerable demand for it. There are a number of points favorable to quarrying of this sandstone, as the jointage of this Triassic formation, which eliminates the necessity of heavy blasting. Where these joints are not sufficiently close together, light blasts are necessary and the large blocks loosened are afterwards split up into the desired size by means of plugs and feathers driven into a line of holes marking the desired break. Nearly all of the sandstone is rifted parallel to the bedding planes, but it will be found that it splits nearly equally well in either direction.

The production of sandstone in 1901 was valued at $11,682 and was used for building purposes; for road making; and ballast. This is a decrease of $15,528 as compared with the production of 1900, which was valued at $27,210.

GRANITE.

Granite quarrying is the most extensive of any of the stone trades in the State, and there are numerous deposits of good grades of granite that offer very favorable opportunities for quarrying. Near the city of Raleigh, Wake county, there are a number of quarries that have furnished a hard, tough, fine-grained, gray gneiss-granite; some of which is favorably located for quarrying and is worthy of investigation. At Wyatt a pink granite is found; and near Rolesville a gray granite occurs abundantly. Twelve miles west of Springhope, Nash county, there are extensive beds of gray biotite-granite of medium grain. In the vicinity of Oxford, Granville county, and Warren Plains, Warren county, a fine light gray granite is to be found that works well. At Greystone, Vance county, a fine-grained gray granite is being quarried. A very pretty mottled porphyritic granite occurs near Lilesville, Anson county. A few miles south of Wilson, Wilson county, there are considerable beds of coarse, red, feldspathic granite, which takes a good polish, closely resembling red Scotch granite.

Building stones are abundant in the higher portions of the Piedmont Plateau region. The more important quarries are in the vicinity of Dunn mountain, Rowan county, 4 to 5 miles east of Salisbury; at Concord, Cabarrus county; Mooresville, Iredell county; and Mt. Airy, Surry county.

The Dunn mountain region is an exceedingly valuable and extensive granite area, which includes Dunn mountain and the adjoining ridge for two miles to the south. It is now being very extensively worked by a number of companies. There are two types of granite obtained from this section; one a medium fine-grained granite of a gray color, and the other, which is similar in texture but has a decidedly pinkish color. The general chemical composition of this pink granite is as follows:

ANALYSIS OF PINK GRANITE FROM DUNN MOUNTAIN, ROWAN COUNTY.

	PER CENT.
Silica (SiO_2)	75.14
Alumina (Al_2O_3)	8.61
Ferric Oxide (Fe_2O_3)	7.42
Manganese Oxide (MnO_2)	Trace.
Lime (CaO)	0.93
Magnesia (MgO)	0.04
Soda (Na_2O)	5.82
Potash (K_2O)	2.57

The Dunn mountain granite makes a good builidng stone and with the present railroad facilities should be operated upon a much larger scale than at present. A more vigorous and extensive system of advertising will create a larger demand for the stone and it can readily enter into competition in price and quality with granite of other States. This is true also of the Mount Airy and other quarries. The Mt. Airy quarries are perhaps the best known of any quarries in the State and have been the most extensively developed. They are located about two miles east of the town of Mount Airy in a solid hill of granite which rises nearly 130 feet above the surrounding valley. The stone is a nearly white granite of uniform grain and texture, and does not exhibit any iron or other injurious accessories. An analysis of this granite gave the following:

ANALYSIS OF GRANITE, MOUNT AIRY QUARRY.

	PER CENT.
Silica (SiO_3)	70.70
Alumina (Al_2O_3)	16.50
Ferric Oxide (Fe_2O_3)	2.34
Pyrite (FeS_2)	0.09
Lime (CaO)	2.96
Magnesia (MgO)	0.29
Potash (K_2O)	2.45
Soda (Na_2O)	4.56

In Davie county there is a very unique but beautiful stone, called "oblicular granite" that is found at Cooloomee, on property belonging to Mr. Frank Hairston. This granite wears well, takes a good polish, and should prove of value as an ornamental stone. The stone consists of a ground mass of quartz and feldspar in which are imbedded around masses of a radiating green augite which are at times more than an inch in diameter.

In the mountain region the principal quarrying has been in the vicinity of Balfour, Henderson county, and Asheville, Buncombe county. At the Balfour quarry, which is nearly one mile southeast of Stony mountain, the stone is a laminated gneiss which at times contains large plenocrysts of feldspar, and while at present it is being used largely for railroad ballast, it is also being cut in dressed as well as rough building stones and is giving good satisfaction. The Corn quarry, about one mile northeast of the Balfour, is a nearly white stone which makes a very attractive decorated or front building stone, and is being quarried on a small scale.

There has been a constant increase in the production of North Carolina granite in the past few years and a considerable demand is arising for it outside the State, but which should be very much larger. The total value of all the granite produced in 1901 was $264,402 as compared with $257,962 in 1900.

In the following table is given the different uses for which the granite has been used:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901.

Uses.	Value.
Building and monumental purposes	$ 108,574
Paving blocks	10,662
Curbing and flagging	56,245
Crushed stone for road-making and railroad ballast, etc.	89,425
Total value	$ 264,906

MARBLE.

Marble occurs very extensively in Swain and Cherokee counties and is associated with the talc deposits described on page 66. The marble varies in color from white to pinkish and bluish. While a great deal of the marble has been too much broken in connection with the folding and general up-lift of the rocks of the region to be available as a building stone, there are, however, a number of deposits in which it is of considerable economic importance. The Kinsey quarry some four miles southwest of Murphy is the only one that has been operated during 1901. The marble here is of a pinkish-white and bluish-gray color to white, and of a uniform texture. There is a very promising deposit near Andrews, Cherokee county, on the property of Mr. C. N. Hickerson, across the river from the railroad depot. The deposit here has been tested by boring at a number of places, and it was found to exist in quantity and to be suitable for building and ornamental purposes. It is white and bluish-gray in color and some has a very pretty mottled appearance. It is fine-grained and compact, and the white variety gives indications of being available for a statuary marble. Below are given partial analysis of the pinkish marble (1) and bluish marble (2) from the Kinsey quarry and the white marble (3) from the Hickerson deposit:

ANALYSIS OF MARBLE FROM THE KINSEY AND HICKERSON DEPOSITS.

	PER CENT.		
	1	2	3
Insoluble residue	2.90	2.80	1.58
Lime (CaO)	49.10	52.30	32.42
Magnesia (MgO)	3.67	0.50	19.58

The first two represent lime marble and the latter a dolomitic marble. It is very probable that the sample from the Hickerson property was near the contact of the talc deposits or quartzite, for it has been observed that all the marble in proximity to the contact that has been examined was dolomitic in character, but further away from the contact it was more of a lime marble.

Four miles a little north of east of Murphy a little development work has been done during 1901 and a quarry has been opened which it is expected will be producing during 1902. This work has been done by the National Marble Company of Murphy, North Carolina.

In Swain county one of the most promising deposits is the Hewitt quarry, near Hewitt station on the Southern Railroad, and is favorably located for quarrying. Tests made upon this marble have shown it to be of very good quality and well adapted for building, both for outside and inside purposes; and it has a high resistance to disintegration by frost. A partial analysis of this marble is as follows:

	PER CENT.
Silica (SiO_2)	0.95
Lime (CaO)	52.33
Magnesia (MgO)	1.69
Carbonic Acid (CO_2)	43.20

This shows the stone be a very pure lime marble.

A very extensive deposit of a dolomitic marble occurs about 10 miles north of Marion, McDowell county. It is fine-grained and in color is usually white, but at times it is distinctly blue. Portions of the stone are well suited for building or ornamental purposes. Its chemical composition is indicated in the partial analysis given below:

ANALYSIS OF MARBLE FROM McDOWELL COUNTY.

	White Marble.	Blue Marble.
	PER CENT.	PER CENT.
Silica (SiO_2)	0.60	1.40
Lime (CaO)	30.29	29.23
Magnesia (MgO)	21.22	19.58

Nearly all of these marbles would burn to excellent lime, and as nearly all the lime used in North Carolina is imported, the waste product in quarrying should be utilized for this purpose.

There was no production of marble reported in 1901. Thus far there has been practically no attempt made to utilize the waste marble obtained in quarrying, either for burning to lime or for any other purpose. The National Marble Company expect to utilize their waste marble by making lime.

LIMESTONE.

Limestone is found quite widely distributed in North Carolina and has been quarried to some considerable extent for making lime and also for building and paving purposes. Besides the marbles (metamorphosed limestones) of Cherokee and Swain counties, limestone is found quite extensively in Henderson, Transylvania, Madison and Wake counties. The limestone in Henderson and Transylvania counties is from bluish to a nearly pure white in color and is partially metamorphosed. It occurs in the valley of the French Broad river from near Mill river to above Brevard. Limestone of fair quality is found in the vicinity of Hot Springs, Madison county. The Wake county deposits are in the vicinity of Raleigh.

In the eastern counties, especially New Hanover, an impure limestone occurs that offers possibilities for burning to lime or for use in the manufacture of cement.

The larger proportion of the lime used in North Carolina is brought in from Tennessee and Virginia, and the manufacture of lime from the North Carolina limestone deposits offers a very promising field of investment, for the best quality of lime can be made from the limestone from the western counties, and if the limestone deposits of the eastern counties will make a good lime or cement, they offer good shipping facilities for the manufactured product.

The production of lime in 1901, valued at $11,963, was obtained from New Hanover, Pender, Wake, Henderson, and Transylvania counties; and was used for the following purposes:

USES OF LIMESTONE MINED IN 1901.

Uses.	Value.
Building purposes	$ 237.50
Made into lime	3,688.00
Road materials, curbing, etc.	4,668.00
Total value	$ 8,356.50

Slate.

Slate of good quality is found in the vicinity of Egypt, Pittsboro, and Goldston, Chatham county, and near Albemarle, Stanly county. It has also been found in Durham and Alamance counties, but its actual value has not been determined. There was no production of slate during 1901.

Serpentine.

Deposits of massive serpentine of a light to dark-green color have been found at a few places in North Carolina and they are in nearly every particular identical with those of Maryland, Delaware and Pennsylvania, which have been worked for building purposes. As far as can be judged from what can be seen of the deposits, they are as well adapted to architectural purposes as those of the Northern States.

The stone is compact and worked easily, but at the same time it is tough and wears well. It takes a fine polish and the dark green and mottled varieties give a very rich effect, while the lighter colors, though somewhat peculiar, are not unpleasing. It is used as both an exterior and interior building stone, but it is better suited and much more effective as an ornamental stone for interior decorations.

There are a number of outcrops of serpentine in Buncombe county between Weaversville and Leicester in a formation that crosses the French Broad river a mile below Alexander. The serpentine here is of first-class quality and its nearness to the railroad makes it a very promising deposit for quarrying. Other deposits which are as large and of about the same quality are on Paint Rock of Ivy creek, Madison county, and on Bald creek, Yancey county. These are, however, at the present time too far from railroad transportation. Another deposit that is worthy of investigation is the one in which the asbestos occurs that is described on page 97. At the bottom of the cut referred to, the serpentine was of good color, hard and compact, and takes a good polish. It is within three-fourths of a mile from the railroad, and water-power is available for sawing the stone.

Thus far no attempt has been made to utilize the North Carolina serpentines, but the Buncombe county and Wilkes county deposits are well worthy of further investigation as to the actual amount of good stone that they are capable of producing. When once this stone has begun to be marketed, there is little doubt but that the demand for it will rapidly increase.

CLAY.

Under this head are included all the clays of whatever character, from the purest kaolin to the most impure brick clay, that have been utilized in any way for commercial purposes. All clays are mixtures of the mineral kaolinite with more or less quartz and other mineral fragments (silicates) oxides, etc.), possessing usually some placticity when mixed with water; and being capable of becoming converted into a hard, rock-like mass when subjected to a high heat. An absolutely pure clay would be composed simply of this mineral kaolinite and where there are nearly pure masses of this they are known as kaolin, and they form the more valuable clay deposits. As kaolinite is not an original mineral, so all our clays are the result of the alteration or decomposition of other minerals, which are for the most part feldspars. These feldspars sometimes occur in nearly pure large masses, as in some pegmatitic dikes, the alteration of which have formed some of the finest beds of kaolin. They also form one of the principal constituents of a large class of rocks, as granites, gneisses, etc., which in their subsequent alteration and disintegration have formed beds of clay. This change that takes place in the minerals of the rocks is due largely to percolating waters containing oxygen and carbon dioxide which are able to penerate into the most remote cracks and crevices of the rocks and thus under pressure, attack the different minerals. In the case of these feldspars, which are essentially potassium and sodium aluminum silicates, the alkalies (sodium and potassium) are removed in the form of carbonates, while the remaining alumina and silica are hydrated, forming the mineral kaolinite. Where the feldspar occurs in large vein-like masses, the result would be beds of nearly pure kaolin, but where it is a constituent of some large rock mass, the resulting product is one of the impurer clays.

This resultant clay materials may be deposited at or very close to the place where they originated, when they are known as residual clays; or they may have been washed down and deposited in ponds, lakes and seas as sediment, with the addition of other mineral substances, when they are known as sedimentary clays. The residual clays are of a sandy nature, and because of their porosity more care is required in burning them. They often contain many angular grains and fragments of wholly or partially decomposed mineral matter; and the banded structure of the original rock from which the clay originated can often be observed extending up into the clay. Residual clays are to be found all over the Piedmont Plateau and mountain regions of the State, and their thickness depends upon the depth to which the alteration of the rocks from which they have been derived, has extended; and also on the slope of the land.

Sedimentary clays generally make a smoother, denser brick, and one which burns at a lower temperature. These are commonly found underlying the terraces along rivers, or else in the bottoms of the valleys, where they represent the remains of deposits of sediment in old lakes and ponds. These are found in the Coastal Plain region as well as the Piedmont Plateau and mountain regions.

North Carolina is well supplied with clays of all descriptions, and especially of residual clays, and the great quantity of these has had a somewhat injurious effect upon the clay industry for the reason that in the erection of many cotton mills and other buildings, the contractor has tried to utilize the nearest bed of residual clay (the more siliceous the better he likes it) in the manufacture of the brick for the buildings. Sometimes a good brick would be made, more often a poor one. This is due sometimes to a poor clay, but it is more often due to the contractor trying to make the brick at a minimum amount of labor and expense. Frequently brick are used, the contents of which will hardly stick together. The clays for making common building brick and pressed brick are just as important and should be given as much care as stoneware clay and china clay (kaolin).

The clays can be treated to advantage by taking them up under the following heads: Kaolin, or China Clay; Pottery Clay; Fire and Pipe-clay; and Brick-clay.

KAOLIN OR CHINA CLAY.

Kaolin has been found in a number of widely separated localities n North Carolina, especially in the mountain region, in the form of xtensive veins or dikes which were formerly composed largely of feldpar, but which have decomposed from the action of atmospheric gencies and formed this clay. Associated with the kaolin there is lways some quartz and mica which were original constituents of the ike or vein. The best kaolin deposits are those in which the feldpar formerly largely predominated in the dike. These dikes vary nsiderably in size, ranging from a few inches to several hundred et in thickness and up to several hundred yards in length. They e usually parallel to the schistosity of the crystalline rocks. At the resent time kaolin is being mined at a number of places in the vinity of Webster, Sylva and Addie, Jackson county, and Bryson

City, Swain county. The kaolin deposit that has been worked the most extensively is the one near Webster and known as the Harris mine. This has been worked to a depth of 120 feet, below which point the material becomes harder and does not permit of cheap mining operations. The dike in which this mine occurs has a thickness of nearly 200 feet and has been traced across the country for a distance of more than half a mile. Similar but smaller kaolin dikes are common throughout the Mountain and Piedmont plateau regions, but in order to be successfully worked they must be near railroad facilities.

There is a promising deposit of kaolin near West's Mill, Macon county, on the land of Geo. Brindel. It is of remarkable whiteness; burns to a pure white color; is very fine-grained, free from grit, and shows a few scattered scales of mica. There is also a promising prospect near Liberty Church, Cowee valley. These deposits are at the present time too far from railroad facilities to be of commercial value, but with the advent of the proposed railroad from Talulah Falls, Georgia, to Franklin, Macon county, these deposits will be available. The kaolin deposit on the property of the National Abrasive Manufacturing Company near Hall, Jackson county, has been developed to a slight extent and the clay is of a good quality. It gives indications of occurring in quantity, and as it is not far from the railroad, should make remunerative mining. Near Bostick Mills, 14 miles north of Rockingham, Richmond county, there are extensive deposits of kaolin, which are near railroad transportation and are well worthy of further investigation. There are promising deposits of kaolin that are known to occur 4 miles west of Troy, Montgomery county; near North Wilkesboro, Wilkes county; and in Beaver Dam township, 2 miles southwest of Canton, Haywood county, on land belonging to J. B. Rhodarmer, which is of good quality and apparently in quantity as shown by a shaft 18 feet deep that has been sunk on the deposit.

The most noticeable change that has occurred in the kaolin industry in the State during 1901 is the opening of the mines in Swain county and the erection of a plant for cleaning and preparing the kaolin for market. The Harris mine is still the largest producer of kaolin in the State and is located near Webster, Jackson county. There was a considerable increase in the production of kaolin in 1901 which was 15,575 tons valued at $119,171.83 as compared with 7,000 tons valued at $62,440 in 1900. This increase is partially due to the opening of the Swain county mines. The above figures are for both the washed kaolin prepared for market, and the raw kaolin sold during 1901. There is a good demand for this North Carolina kaolin at the present market price of $8.50 to $9.50 per ton, numerous inquiries being received for information regarding the location of kaolin deposits.

The kaolins of North Carolina, where they contain less than one per cent. of ferric oxide, are well adapted to the manufacture of white earthenware or china; and also of the best grades of porcelain. Where the percentage of ferric oxide is from 1 to 2 per cent., the kaolin could probably be used for the lower grades of white earthenware, while those containing from 2 to 2½ per cent. of this oxide could perhaps be used to advantage by mixing with fire clays in the manufacture of refractory apparatus.

POTTERY CLAYS.

There has been but little development of the pottery industry in North Carolina, and although there are 40 or more potteries in the State, they are all small and for the most part are making inferior grades of ware. By far the larger proportion of the earthenware and stoneware used in the State is imported, while it should be manufactured at home. There are plenty of clays suitable for this purpose, which are the finer aluminous sediments underlying the river terraces and which are found in many of the broader valleys, the better clays being usually found near the shore line of the terraces. In using the term pottery clay, it is meant to include those clays that are used to make the lower grades of earthenware and stoneware, the higher grades of pottery being made from kaolins. In the manufacture of common earthenware, which would include flower-pots, almost any red burning plastic clay that permits turning on the potter's wheel and burns to a good red without vitrifying, can be used. In the manufacture of stoneware a better quality of clay is required and the requisites for such clays are that they should possess good plasticity in order to permit molding or turning without cracking; their tensile strength should be not less than 125 to 150 pounds per square inch; they should not shrink excessively in burning; and should burn to a dense vitrified body, if possible, at a temperature of 2,000 degrees to 2,100 degrees F. They should permit of rapid drying and be as smooth and free from grit as possible. Such clays are found underlying the terraces along the Catawba river north of Morganton and Mt. Holly, Burke county, and near Blackburn and Catawba, Catawba county; the South Fork of the Catawba river, just north of Lincolnton, Lincoln county; the Yadkin river near Wilkesboro, Wilkes county; and Elkin, Surry county; including the old terraces of the Deep river near Ulah and Why Not, Randolph county. In the eastern part of the State along the Cape Fear river near Fayetteville, Cumberland county; the Neuse river near Goldsboro, Wayne county; and Contentnea river, a tributary of the Neuse, in Wilson county, near Wilson, are similar deposits of clay.

There have been 43 pottery manufacturers who responded to inquiries regarding the amount of pottery made by them in 1901 and they reported a total production of $22,495, which is an increase of $3,632 over the production of 1900, which was valued at $18,863. The production of 1901 was divided as follows: For earthenware, $4,490; stoneware, $17,453; and decorative ware, smoking pipes, etc.; $552, as compared with $1,937 of earthenware; $16,498 of stoneware; and $428 of decorative ware in 1900.

While there has been this increase in the value of the production of pottery in 1901, it does not begin to represent the value of what should be produced in the State. With the application of the improved methods, with more care, and by using better material for glazing the ware, the North Carolina potter would be able to put a far better grade of pottery on the market, which would sell at a correspondingly increased price.

In the following table is given a statement of the value of the pottery products by counties and of the value of the earthenware, stoneware and decorative ware made in each county:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES IN 1901.

County.	Earthenware.	Stoneware.	Decorative Ware, etc.	Total.
Buncombe	$ 220	$ 3,100	$	$ 3,320
Catawba		2,540		2,540
Chatham		2,700		2,700
Cumberland	60			60
Johnston	525	1,700		2,225
Lincoln	2,500	2,000	25	4,525
Randolph	860	3,173	200	4,233
Union	325	1,040	27	1,392
Warren			300	300
Wilkes		1,200		1,200
Total value	$ 4,490	$ 17,453	$ 542	$ 22,495

As is seen from the above table, the pottery products are confined for the most part to stoneware and that the amount of decorative ware or fancy ware is extremely limited.

Fire Clay and Pipe Clay.

There are but few known occurrences of deposits of fire clay in North Carolin. The main point desired in a fire-clay is a refractory character and it should also possess good plasticity, low shrinkage, and should be unaffected by a temperature of 2,500 degrees F. (although brick are sold as fire brick which are affected by a temperature of 2,100 degrees F.). Such clays are known to occur at Pomona, Guilford county; Grover, Cleveland county; and Emma, Buncombe county. A clay has also been reported from Cherokee county, about 4 miles east of Murphy, that is suitable for making fire brick and also one near Wilson's Mills, Johnston county. The fire clay from Emma, N. C., has recently been tested by Dr. Heinrich Ries, who heated it to a temperature of about 3,000 degrees F. and it only showed the very finer particles to have been attacked and viscosity occurred at a temperature of 3,250 degrees F. These tests show the clay to have qualities that adapt it for manufacturing into fire brick. The company operating the clay deposits at Emma expect to increase their plant so that they can manufacture fire brick.

There were not many fire brick made during 1901, and they were valued at $550, as compared with a production valued at $714 in 1900.

The requisites desired in clays for the manufacture of sewer pipe are that they should be plastic to permit molding without cracking; have a tensile strength of 125 to 150 pounds; burn to a dense, hard, impervious body of a red or deep red color, and dry and burn with rapidity without the ware warping or cracking. The principal manufacturers of sewer pipe and tile is the Pomona Terracotta Company at Pomona, Guilford county, North Carolina, and they have been constantly increasing the production of their plant. This plant illustrates what can be done with the clays of North Carolina when they are worked on a large scale and by improved methods. The value of the total production of sewer pipes, tile, etc., produced in 1901 was $55,745.05 as compared with $54,796 in 1900.

Brick Clay.

There are in the greater number of the counties throughout North Carolina clay deposits that are suitable for the manufacture of brick, and they consist of both residual and sedimentary clays. These clays vary in composition both with the character of the rocks from which they have been formed and with the extent to which the materials and the original rocks have been separated by the sorting action of water in transporting these from one place to another. They are usually of a reddish or yellowish color, due to the presence of iron oxide. Although there is a great deal of work being done on the brick clay deposits throughout the State, it is for the most part confined to the manufacture of common brick and there is but little attention being given to the manufacture of pressed, front, or fancy brick. This is not because the clays are not adapted to the manufacture of these brick, for there are many clay deposits that are capable of being made into an excellent pressed or front brick, as those near Asheville, Buncombe county, Wilkesboro, Wilkes county, Goldsboro, Wayne county, etc. Many of these places are at the intersection of several lines of railroad so that the products would have good railroad facilities for shipment. When it is considered that the larger proportion of the pressed and fancy bricks used in this State are now being imported, it will be seen that there is good opportunity for the development of this branch of the clay industry in North Carolina. Even in the manufacture of common brick the industry is not what it should be, for in many cases the crudest methods are used in their manufacture, and sufficient care is not taken in burning them, so that the result is often a brick of poor quality that will not stand shipment. This also means that a lower price is obtained for the brick. With such favorable opportunities as are offered for making brick in many places in North Carolina, there should be a large increase in their production, especially of fancy and pressed brick; and in a better quality of common brick.

The number of brick made in North Carolina during 1901 was 135,566,570 valued at $710,680.84, this being an average value of $5.22 per thousand. This is a decrease of 13,051,430 brick, and of $30,922.84 in value as compared with the production of 1900, which was 148,618,000 brick valued at $741,602. The lowest value recorded for brick was $2.33 per thousand and the highest $10, except in one instance, when $20 per thousand was reported for a special vitrified brick. The highest price recorded as having been received for common brick was $8 per thousand. There were in all 231 manufacturers engaged in making brick during 1901, who made replies regarding their production. In the following table is given the total number of and value of brick produced in 1901 by counties and also the number and value of common brick, pressed brick, and vitrified or paving brick.

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1901.

COUNTY.	Common Brick.	Value.	Pressed Brick.	Value.	Vitrified Brick.	Value.
Alamance	4,408,000	$ 21,665.00	--------	$--------	--------	$--------
Anson	600,000	3,000.00	--------	--------	--------	--------
Beaufort	1,695,000	10,480.00	--------	--------	--------	--------
Bertie	575,000	2,850.00	30,000	240.00	--------	--------
Bladen	450,000	2,250.00	--------	--------	--------	--------
Buncombe	2,084,250	10,594.80	200,000	2,400.00	--------	--------
Burke	1,075,000	4,600.00	25,000	200.00	--------	--------
Cabarrus	3,050,000	15,250.00	--------	--------	--------	--------
Caldwell	1,570,000	6,410.00	--------	--------	--------	--------
Carteret	450,000	2,425.00	--------	--------	--------	--------
Catawba	845,000	4,050.75	--------	--------	--------	--------
Chowan	1,000,000	7,000.00	--------	--------	--------	--------
Cleveland	1,500,000	8,100.00	--------	--------	--------	--------
Columbus	2,400,000	12,450.00	--------	--------	--------	--------
Craven	3,250,000	16,750.00	--------	--------	--------	--------
Cumberland	1,500,000	7,500.00	--------	--------	--------	--------
Davidson	1,560,000	7,400.00	--------	--------	--------	--------
Davie	2,500,000	15,000.00	--------	--------	--------	--------
Duplin	237,000	1,306.00	--------	--------	--------	--------
Durham	8,425,000	40,275.00	10,000	100.00	--------	--------
Edgecombe	3,465,000	20,270.00	--------	--------	--------	--------
Forsyth	10,492,000	48,206.00	--------	--------	--------	--------
Franklin	500,000	3,500.00	--------	--------	--------	--------
Gaston	3,150,000	15,630.00	--------	--------	--------	--------
Gates	100,000	425.00	--------	--------	--------	--------
Granville	1,250,000	6,250.00	--------	--------	--------	--------
Greene	1,101,086	6,653.48	--------	--------	--------	--------
Guilford	10,238,000	53,025.75	170,000	1,700.00	100,000	750.00
Halifax	2,160,000	12,460.00	100,000	1,000.00	--------	--------
Harnett	1,000,000	5,600.00	--------	--------	--------	--------
Haywood	500,000	2,500.00	--------	--------	--------	--------
Henderson	2,950,000	14,325.00	--------	--------	--------	--------
Iredell	1,907,000	8,885.00	--------	--------	--------	--------
Jackson	3,000	18.00	--------	--------	--------	--------
Johnston	1,435,000	8,350.00	--------	--------	--------	--------
Lenoir	2,500,000	13,000.00	--------	--------	--------	--------
Lincoln	450,000	2,250.00	--------	--------	--------	--------
McDowell	1,100,000	6,300.00	--------	--------	--------	--------
Martin	55,000	328.00	--------	--------	--------	--------
Mecklenburg	7,485,000	41,062.00	--------	--------	--------	--------
Montgomery	50,000	20.00	190,000	1,130.00	--------	--------
Moore	1,635,050	10,220.00	--------	--------	--------	--------
Nash	6,420,000	24,100.00	--------	--------	--------	--------
New Hanover	1,000,000	3,000.00	--------	--------	--------	--------
Orange	825,000	4,345.00	--------	--------	--------	--------
Pasquotank	1,700,000	10,200.00	25,000	250.00	--------	--------
Person	600,000	3,000.00	--------	--------	--------	--------
Pitt	320,263	1,794.73	100,000	1,000.00	--------	--------
Randolph	697,571	2,942.02	25,000	150.00	--------	--------
Robeson	1,545,000	8,689.00	--------	--------	--------	--------
Rockingham	860,000	3,850.00	--------	--------	--------	--------
Rowan	3,760,000	18,400.00	--------	--------	--------	--------

COUNTY.	Common Brick.	Value.	Pressed Brick.	Value.	Vitrified Brick.	Value.
Rutherford	1, 602, 000	$ 7, 783. 00	---------	---------	---------	---------
Sampson	425, 000	2, 350. 00	---------	---------	---------	---------
Scotland	1, 000, 000	5, 000. 00	---------	---------	---------	---------
Stanly	300, 000	1, 500. 00	---------	---------	50, 000	500. 00
Surry	1, 565, 000	7, 125. 00	90, 000	750. 00	---------	---------
Transylvania	187, 000	875. 00	---------	---------	---------	---------
Union	2, 304, 000	11, 415. 00	---------	---------	---------	---------
Vance	100, 000	700. 00	---------	---------	---------	---------
Wake	3, 977, 400	22, 357. 31	50, 000	500. 00	---------	---------
Warren	150, 000	750. 00	---------	---------	---------	---------
Washington	300, 000	1, 800. 00	---------	---------	---------	---------
Wayne	7, 550, 000	39, 450. 00	---------	---------	10, 000	200. 00
Wilkes	585, 000	2, 865. 00	30, 000	300. 00	---------	---------
Wilson	2, 950, 000	17, 700. 00	50, 000	400. 00	---------	---------
Yadkin	63, 000	315. 00	---------	---------	---------	---------
Total	134, 441, 570	697, 860. 84	1, 095, 000	10, 220. 00	180, 000	1, 650. 00

Of the 97 counties in North Carolina all but 31 reported some production of brick. The largest number of brick were made in Guilford county and amounted to 10,238,000 valued at $53,025 or $5.07 per thousand. Jackson county produced the smallest number, which amounted to 3,000 bricks valued at $18.

In the following table are given the value of the clay products produced in 1900 and 1901:

VALUE OF CLAY PRODUCTS OF NORTH CAROLINA IN 1900 AND 1901.

	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
Common brick	148, 177, 000	$ 737, 577. 00	134, 441, 570	$ 697, 860. 84
Pressed brick	441, 000	4, 025. 00	1, 095, 000	10, 220. 00
Vitrified brick	------------	------------	180, 000	1, 650. 00
Fire brick	------------	714. 00	------------	550. 00
Earthenware	------------	1, 937. 00	------------	4, 490. 00
Stoneware	------------	16, 498. 00	------------	17, 453. 00
Decorated ware	------------	428. 00	------------	552. 00
Sewer-pipe, etc.	------------	54, 796. 00	------------	55, 745. 05
Kaolin	7, 000 tons	62, 440. 00	15, 575 tons	119, 171. 83
Fire clay	------------	------------	33½ tons	100. 00
Total value		$ 878, 415. 00		$ 907, 789. 72

In the aggregate the clay industry in the State becomes an important one, but there is still much room for improvement, and not only should the actual production be greater, but still more so should the value of the production increase. The above statistics regarding the clay production of the State do not represent the entire production, for there have been a number of the producers of clay products that have been very reticent in responding. This has not only caused the statistics regarding clay products of the State to appear lower than they should, but it also reduces the value of the mineral production that is given under the head of the different counties. It is to be hoped that another year those interested in the development of the different mineral products of the State will be more prompt to send in their statistics.

OTHER ECONOMIC MINERALS.

There are a number of minerals that are found in quantity in North Carolina that have a commercial value, but are not being mined at the present time. There are still others which give indications of occurring in quantity and are worthy of further investigation. A brief description is given of the more important of these minerals, including their uses, value, modes of occurrence, etc.

CHROMITE OR CHROMIC IRON ORE.

Chromite is a mineral that usually occurs massive with a fine granular to compact structure. When crystallized it is usually in small octahedrons. It is brittle, breaks with an uneven fracture and has a hardness of 5.5, which is about the same as hard steel. In color it varies between iron-black and bluish-gray and has a submetallic to metallic luster. Its theoretical chemical composition is represented by the formula $FeO\ Cr_2O_3$, a combination of chromium sesquioxide and iron protoxide; but it is usually found that a portion of the iron is usually replaced by varying amounts of magnesium and the chromium by aluminum.

The uses of this mineral are in the production of the salts chromate and bi-chromate of potash which are used particularly in dyeing and in the manufacture of coloring pigments; in the manufacture of ferro-chromium alloys which are used very extensively in the manufacture of chromium steel. The mineral itself is being used in the manufacture of brick for use in basic open-hearth furnaces. It is also being used directly for linings of various furnaces and where used has given satisfaction. In this connection it is used as a lining for furnaces for smelting copper and this should make the North Carolina ores valuable for the Ducktown, Tennessee deposits and the Gold Hill, Ore Knob, and Blue Wing deposits of North Carolina.

The value of a chrome ore depends upon the percentage of chromic oxide (Cr_2O_3) that it contains, standard ore containing 50 per cent. of this oxide. For every unit above 50 per cent. there is an increase in value of 75 cents to $1 per ton; but below 50 per cent. there is a much greater deduction per unit. Ores low in silica are the more valuable, and even when they contain but 45 per cent. of the chromic oxide they find a market if they are low in silica.

With the exception of alluvial deposits, chromite has been found only in peridotites and allied igneous basic magnesian rocks or in serpentines which have resulted from the alteration of these rocks. In the alluvial deposits at the base of these rocks there is usually a considerable amount of chromite in crystals and small particles and in certain localities they have been observed in sufficient quantity to constitute a chrome sand ore. In the North Carolina peridites chromite occurs more commonly in grains or crystals and also in embedded masses near the boundary of the lenticular masses of these rocks. The general character of the chrome ore is nearly uniform throughout the entire area, being very hard and compact, though often of a fine granular appearance, and there is but little that is at all friable. The masses of chromite are usually very free from seams containing peridotite or its alteration product serpentine and a high grade ore can usually be obtained by hand-cobbing.

While chromite is found almost universally associated with the peridotites of North Carolina, it is only in a few localities that it occurs in quantity and a brief description of these is given below. One of the most promising deposits in the State is in Yancey county at Mine Hill on Mine Fork of Jack's creek, alongside of the Bakersville road, 5 miles north of Burnsville, the county-seat. The ore occurs in a large peridotite formation which outcrops on both sides of the road. What little work has been done on this deposit gives indication that chromite occurs in quantity. With the completion of the railroad from Erwin, Tennessee, to Marion, North Carolina, this deposit should become available for commercial purposes. An analysis of a selected sample of this chromite showed 58 per cent. of chromic oxide, but judging from the character of the ore, a 52 per cent. ore can probably be readily obtained by hand-picking and cobbing. This property is owned by Mr. Garrett Ray of Burnsville.

Associated with the large peridotite area or formation in the vicinity of Webster, Jackson county, chromite has been found quite abundantly at a number of points near the contact of the peridotite with the country rock. The principal work has been done on the lands of David Schneider, Joseph Hooker, Lawrence Buress, Alf. Wilson, James Ashe and Daniel Fulbright, all of Webster, North Carolina. The work done shows the presence of a considerable amount of chromite, but it is not sufficient to demonstrate whether it is to be found in sufficient quantity to make profitable mining. These chromite deposits would be from 3 to 5 miles from the railroad.

Another property that is being developed is on Big Ivey Creek in Buncombe county, about 16 miles northwest of Asheville, and 9 miles from the railroad. There is considerable chrome sand on the property, which is readily concentrated, and, as reported, the concentrates contain 54.09 per cent. of chromic oxide. The rock ore, which had been hand-cobbed, gave on analysis 48.78 per cent. of chromic oxide. This property is being developed by Mr. F. L. Plaisance of Asheville.

A promising deposit of chromite occurs in the Balsam Gap peridotite area and is located on both sides of Dark Ridge creek about 175 yards to the south of the Dark Ridge trestle of the Murphy branch of the Southern Railroad. A number of open cuts and pits have been made which show the presence of chromite in some quantity. There is a large quantity of float ore in the vicinity which, with a nearness to the contact of the peridotite and gneiss and the pockets and veins already uncovered, point to this locality as a promising one for further development; and its nearness to the railroad is also greatly in its favor.

All North Carolina ores are high grade, but the existence of large deposits have not as yet been conclusively shown; but the four localities mentioned above are worthy of further investigation.

ASBESTOS.

There are two minerals that are mined and put on the market as asbestos which are very similar in their physical properties, but are distinct chemically. One, a variety of the mineral amphibole, is a silicate of calcium and magnesium and the other a variety of serpentine known as chrysotile, a hydrous magnesium silicate. Both these varieties of asbestos are equal in their heat-resisting properties, but the chrysotile is superior in strength and elasticity of fiber to any variety of amphibole asbestos. The former is usually greenish-white, green to yellowish in color with a decidedly silky luster, while the other is from white to greenish and woody-brown in color and has more the appearance of flax. The fibers of the chrysotile asbestos vary from 1-16th to 3 inches in length while fibers of amphibole asbestos have been found three feet in length. The two varieties can readily be distinguished from each other by testing them for water, the chrysotile being a hydrous mineral and giving off a considerable amount of water when heated. The occurrences of these two varieties are distinct, the amphibole variety being usually found in granitic or schistose rocks, sometimes in pockets and again in well defined veins, while the chrysotile variety is found in seams of varying width, always in serpentine rocks. On account of the many more purposes for which the chrysotile asbestos can be used than the amphibole variety, there is a correspondingly larger demand for this variety.

Where asbestos is used as an ingredient in fire-proof paints, for wall plasters, for packing in the manufacture of fire-proof safes, in the manufacture of boiler coverings and for all purposes where its non-conductivity of heat is the important factor and not the strength of fiber, the amphibole variety can be used and gives as good satisfaction as the chrysotile. On the other hand, however, where the strength of fiber as well as non-conductivity of heat is desired, it is the chrysotile variety that is used, such as in the manufacture of cloth, roping, felt, boards, tubes and washers.

There are a number of localities in North Carolina where the chrysotile variety of asbestos has been found, the most promising of which are in the vicinity of Glennville and of Sapphire, Jackson county, near the mouth of Squirrel creek of North Toe river, along the western slopes of Rich mountain in Watauga county; on Elk creek in Ashe county; and near North Wilkesboro, Wilkes county. At these localities fiber of fair length and fineness has been found which warrant further investigation.

The deposit near North Wilkesboro is within ¾ of a mile of the railroad and occurs in a serpentine formation that is from 75 to about 200 feet in depth and can be traced in a general N. W.-S. E. direction for nearly 600 yards. The deposit has been worked by means of an open cut 100 feet long which was made on the land of Mr. J. B. Church. The cut varies in depth from 1 to 35 feet and near the surface the serpentine encountered was badly decomposed and altered, but at lower depths a compact, dark-green rock was found. This harder rock is similar to a bold outcropping of the serpentine that occurs on a low hill about 300 yards a little east of south of his cut. A similar outcrop of serpentine was observed on the summit of a hill 200 yards nearly north of the cut. In nearly all of this serpentine small seams of the chrysotile asbestos were observed that varied in width from a quarter of an inch to some that were encountered in the bottom of the cut that were nearly two inches wide. These seams run at all angles through the rock and, as the unaltered serpentine was encountered, the asbestos became of better quality. Sufficient work has not been done to demonstrate the actual value of this property as a source of asbestos, but it is worthy of further investigation.

The amphibole variety of asbestos has been found in quantity at a number of localities; near Plumtree, Mitchell county, and on Ellijay creek, Macon county, but on account of their distance from the railroad they have not been able to be worked. There is a very promising locality of this variety of asbestos found on Tryon mountain, Polk county, about 1½ miles west of Skyuka, which has been traced across the country for nearly a mile. It occurs apparently in a series of pockets, one of which was opened and measured nearly 100 feet in width. It is of fair quality and large masses have been taken out in width. It is of fair quality and large masses have been taken out where the fiber was from 10 to 15 inches in length. This property is owned by Mr. D. Stern, Lynn, North Carolina.

ZIRCON.

Zircon, a zirconium silicate ($ZrSiO_4$), is commonly found in square tetragonal prisms terminated by the pyramid, and is usually of a grayish, light brown to a reddish-brown color. It is 7.5 in hardness and has a specific gravity of about 4.65. It is commonly found sparingly in crystalline rocks, especially granular limestone, chloritic and other schists, gneiss, syenite and granite. It has also been found associated with some of the iron ores. The use that has been made of this mineral is for a source of zirconia (ZrO_2), which is used in the manufacture of cylindrical hoods or mantles for certain of the incandescent gas lights. At the present time there is but little of this mineral that is being mined except for experimental purposes. There is one noted locality in North Carolina where this mineral has been found in quantity and this is in the vicinity of Zirconia, Henderson county. The zircons occur in what is apparently a decomposed pegmatitic dike about 100 feet wide and with a strike nearly 50 degrees east. The upper portion of the dike is badly kaolinized which permits an easy separation of the zircon which was done by hydraulic processes. As the vein became more solid it is more difficult to separate out the zircon. They are, however, readily detached from the feldspar matrix as this is broken up. There are two mines on these deposits, one the Jones zircon mine half mile west of Zirconia railroad station and the other the Freeman zircon mine which is one mile west of the Jones. From the work done at these mines, it seems very probable that if the demand does arise for zircon in quantity, that a constant supply can be obtained from these mines. Another promising locality for zircon is near New Stirling, Iredell county.

During 1901 there were about 75 pounds of this mineral valued at $15 sold for experimental purposes.

SUMMARY.

The statistics of the mining industry for 1901 show a decided increase in the production of those minerals that are principally mined in the State; and those which show a less production than of the year before are those whose production is necessarily limited, either because of location or small deposits. The past year has not only seen more values taken out of the mineral deposits of the State than for a number of years past, but has also seen more money invested in thorough and competent development work than ever before. This means that the mineral production of the State will increase at a rapid rate during the next year or two; and with the successful development and operation of the mines it will mean an additional impetus to bring capital into the State.

Some of the most promising mining propositions that are awaiting investigation and the investment of capital are the clay deposits, which are suitable for the manufacture of pressed and fancy brick and pottery; the large deposits of low grade gold ores, to be treated by the cyanide process; graphite deposits; the granite, marble, sandstone and serpentine deposits; and the corundum mines.

In the table below is given the total mineral production of the State for the years 1900 and 1901:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1900 AND 1901.

Mineral.	Value.	
	1900.	1901.
Gold	$ 46,653.00	$ 60,410.71
Silver	15,986.00	34,023.64
Copper	41,600.00	76,900.00
Iron	42,000.00	4,997.00
Pyrite	14,625.00	32,000.00
Corundum	36,840.00	48,840.00
Garnet	18,000.00	43,000.00
Mica, Sheet	65,200.00	79,849.00
Mica, Scrap	36,262.00	14,200.00
Quartz	None.	7,500.00
Barytes	----------	22,615.00
Monazite	48,805.00	59,262.00
Talc	42,000.00	77,974.00
Gem minerals, etc.	12,020.00	24,245.00
Graphite	----------	559.25
Coal	22,500.00	5,585.00
Building stones	285,172.00	284,744.00
Kaolin	62,440.00	119,171.83
Clay products	815,975.00	788,617.89
Total value	$ 1,604,078.00	$ 1,779,109.32

It will be noticed in the above table that in most cases there has been a decided increase in the production of those minerals for which North Carolina is especially noted, as talc, monazite, kaolin, etc., and that the decrease is for the most part in those minerals, the production of which is not expected to amount to very much in this State. This indicates a healthy condition of the mining industry and should give considerable impetus for a greater amount of mining and development work in 1902, for there is an increasing demand for many of these minerals that are being mined.

This mineral production of 1901 was obtained from 75 counties and the value of this production for each county is given in the table below. The clay products are given separately from the rest of the mineral production whose total value is given.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1901.

COUNTY.	Mineral Production, including Kaolin.	Clay Products except Kaolin.	COUNTY.	Mineral Production, including Kaolin.	Clay Products, except Kaolin.
Alamance	$ 400. 00	$21, 965. 00	Jones	$	$
Alexander	175. 00		Lenoir		13, 000. 00
Alleghany	720. 00		Lincoln	100. 00	6, 275. 00
Anson	1, 800. 00	3, 000. 00	McDowell	37, 074. 00	6, 300. 00
Ashe			Macon	58, 180. 00	
Beaufort		10, 480. 00	Madison	14, 795. 00	
Bertie		3, 162. 00	Martin		325. 00
Bladen		2, 250. 00	Mecklenburg	32, 149. 00	41, 062. 00
Brunswick			Mitchell	42, 835. 06	
Buncombe	15, 090. 01	15, 469. 85	Montgomery	2, 000. 00	200. 00
Burke	24, 282. 00	4, 800. 00	Moore	18, 796. 00	10, 220. 00
Cabarrus	22, 426. 71	15, 250. 00	Nash	100. 00	24, 100. 00
Caldwell	70. 00	6, 410. 00	New Hanover	4, 668. 00	3, 000. 00
Camden			Northampton		
Carteret		2, 425. 00	Onslow		
Caswell			Orange		4, 345. 00
Catawba		6, 710. 00	Pamlico		
Chatham	5, 585. 00	2, 700. 00	Pasquotank		10, 450. 00
Cherokee	27, 500. 00		Pender	600. 00	
Chowan	7, 00	0. 00	Perquimans		
Clay	9, 00	0. 00	Person	47, 000. 00	3, 000. 00
Cleveland	17, 532. 00	8, 100. 00	Pitt		1, 794. 73
Columbus		12, 450. 00	Polk	300. 00	
Craven		16, 750. 00	Randolph	20, 165. 00	7, 377. 02
Cumberland		7, 560. 00	Richmond		
Currituck			Robeson		8, 689. 00

County.	Mineral Production, including Kaolin.	Clay Products except Kaolin.	County.	Mineral Production, including Kaolin.	Clay Products, except Kaolin.
Dare	$	$	Rockingham	$	$ 3,850.00
Davidson	2,500.00	7,400.00	Rowan	126,438.15	18,400.00
Davie	15,00	0.00	Rutherford	8,989.64	7,783.00
Duplin		1,306.00	Sampson		9,100.00
Durham		40,275.00	Scotland		5,000.00
Edgecombe		20,270.00	Stanly	2,660.16	2,000.00
Forsyth	3,906.00	48,206.00	Stokes		
Franklin		3,500.00	Surry	88,6	54.00
Gaston	42,279.50	15,630.00	Swain	40,115.00	
Gates		425.00	Transylvania	1,440.00	875.00
Graham			Tyrrell		
Granville		6,250.00	Union		12,807.00
Greene		6,653.48	Vance	18,700.00	700.00
Guilford		110,974.00	Wake	21,034.25	22,357.31
Halifax		13,460.00	Warren		1,050.00
Harnett		5,600.00	Washington		1,800.00
Haywood	13,124.00	2,500.00	Watauga		
Henderson	13,169.43	14,325.00	Wayne		39,450.00
Hertford			Wilkes		5,465.00
Hyde			Wilson		17,700.00
Iredell	70.00	8,885.00	Yadkin		315.00
Jackson	163,641.93	18.00	Yancey	33,995.00	
Johnston		10,575.00			
			Total value	$ 990,491.43	$ 788,617.89

As is seen from the above, of the 75 counties reporting their mineral production, there were but 40 that reported anything besides clay products. The following 18 counties, Ashe, Brunswick, Camden, Caswell, Currituck, Dare, Graham, Hertford, Hyde, Jones, Northampton, Onslow, Pamlico, Perquimans, Richmond, Stokes, Tyrrell, Watauga did not report any production of any mineral whatever during 1901.

Jackson county leads the list in the value of the mineral production (except clay products), their value being $163,641.93, while Guilford county produced the greatest amount of clay products, which were valued at $110,974.

The county whose total mineral production was greatest in 1901 was Jackson, the value of the production being $163,659.93.

BULLETINS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by Joseph A. Holmes and J. Volney Lewis. *In preparation.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and Geo. B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 2 cents.*

8. Water Powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. Mica Deposits and Mica Mining in North Carolina, by Joseph A. Holmes. *In preparation.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparaton.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. Corundum and the Peridotites in Western North Carolina, by J. H. Pratt and J. V. Lewis. *In preparation.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS, No. 1, on the Maple Sugar Industry in Western North Carolina, by W. W. Ashe; No. 2, on recent road legislation in North Carolina, by J. A. Holmes; No. 3, on Talc and Pyrophyllite Deposits in North Carolina, by J. H. Pratt; No. 4, on the Mining Industry in North Carolina for 1900, by J. H. Pratt; No. 5, Road Laws of North Carolina (out of print), by J. A. Holmes; No. 6, on the Mining Industry in North Carolina for 1901, by J. H. Pratt; are also distributed free, on the payment of postage, 2 cents in each case, except No. 6, which requires 4 cents.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

North Carolina
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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper, No. 7

THE MINING INDUSTRY
IN
NORTH CAROLINA DURING 1902

BY

JOSEPH HYDE PRATT
MINERALOGIST

RALEIGH
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1904

North Carolina

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LETTER OF TRANSMITTAL.

Raleigh, N. C., May 1, 1902.

To His Excellency, Hon. C. B. Aycock,
Governor of North Carolina.

Sir:—As the seventh of the series of Economic Papers, I have the honor to submit for publication a report on the *Mining Industry* in North Carolina for 1902. This publication takes up the statistics of the production of the various minerals that were mined in the State during 1902, and is, in some respects, an appendix to the report on the Mining Industry of North Carolina for 1901, which takes up in detail descriptions of the occurrences of the deposits of the economic minerals of the State.

Yours obediently,
J. A. Holmes,
State Geologist.

MINING INDUSTRY IN NORTH CAROLINA DURING 1902.

INTRODUCTION.

The present report of the mining industry in North Carolina during 1902 is simply an appendix to the report for 1901, and is composed principally of tables supplementary to the previous report, with simply sufficient text to make these tables intelligible. A more elaborate report will be published for the mining industry during 1903, which will include descriptions of new mineral localities. From the amount of development work that was being done in the different mineral localities in North Carolina at the close of 1901, it was confidently expected that the mineral production in North Carolina during 1902 would be considerably larger than that of the year before. That these expectations have been realized is shown by the statistics of the production of the various minerals, the aggregate value of which in 1902 was $2,003,077, which is an increase of $223,968 over the value of the total production in 1901, which was $1,779,109.

The more notable changes have been the large increase in the production of gold, copper, iron and barytes, while there was no production of corundum and a large decrease in that of garnet, two minerals which were among the more prominent of those mined in North Carolina. There was also a very material growth in the building stone industry, principally in the production of granite.

A great deal of development work was carried on throughout the State, and a number of new localities opened up, so that at the close of 1902 the condition of the mining industry in North Carolina is very promising for a still further increase in the production of minerals in the State during 1903.

GOLD AND SILVER.

The total production of gold and silver in the State in 1902 was valued at $123,862 (coining value), which is an increase of $29,429 over that of 1901, which was valued at $94,433.

Of this production, the value of the gold was $93,650, this being

North Carolina
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an increase of $33,240 over that of 1901, which was valued at $60,410.

The production of silver in 1902 was $30,212 (coining value), which is a decrease of $3,811 over the production of 1901, this latter amounting to $34,023. Nearly all of the silver was obtained from copper ores that were produced in the State, and this indicates the fineness of the gold.

This production of gold and silver was divided among thirty-three counties. The county producing the largest amount of gold was Montgomery, with a production valued at $38,498; while the smallest production was from Caldwell and Cumberland counties, each of which is credited with a production valued at $18.60. Mecklenburg was the second largest producer of gold, with a production valued at $20,439, and Rowan third, with a production valued at $10,131. The production of silver was confined almost entirely to Rowan and Person counties, from which were also obtained nearly all of the copper produced in 1902. Rowan leads, with a production valued at $16,401, and Person is second, with a production valued at $10,520, their combined value being $26,921, or only $3,291 less than the value of the total production. In the table below is given the production of gold and silver in North Carolina during 1902 (in coining value) by counties:

PRODUCTION OF GOLD AND SILVER IN 1902, BY COUNTIES.*

COUNTY.	GOLD.†	SILVER.†	TOTAL.
Burke	$ 3, 536. 19	$ 42. 07	$ 3, 578. 26
Cabarrus	1, 049. 30	87. 20	1, 136. 50
Caldwell	18. 60	. 11	18. 71
Catawba	1, 544. 93	15. 97	1, 560. 90
Chatham	127. 76	2. 55	130. 31
Cherokee	1, 221. 86	5. 67	1, 227. 53
Clay	198. 14	1. 41	199. 55
Cumberland	18. 60	. 11	18. 71
Davidson	603. 24	367. 77	971. 01
Franklin	625. 77	6. 24	632. 01
Gaston	205. 30	3. 19	208. 49
Granville	253. 23	937. 75	1, 190. 98
Guilford	929. 45	36. 57	966. 02
Halifax	1, 350. 56	5. 14	1, 355. 70
Henderson	490. 19	10. 63	500. 82
Iredell	231. 61	2. 89	234. 50
Lincoln	144. 74	. 54	145. 28
Macon	93. 02	. 58	93. 60
McDowell	2, 048. 85	36. 63	2, 085. 48
Mecklenburg	20, 439. 58	860. 41	21, 299. 99
Montgomery	38, 498. 15	675. 00	39, 173. 15
Moore	542. 75	19. 55	562. 30
Nash	292. 24	6. 79	299. 03
Orange	504. 70	18. 71	523. 41
Person	1, 241. 47	10, 520. 50	11, 761. 97
Polk	1, 325. 70	12. 98	1, 338. 68
Randolph	1, 064. 48	11. 30	1, 075. 78
Rowan	10, 131. 17	16, 401. 86	26, 533. 03
Rutherford	2, 241. 15	27. 96	2, 269. 11
Stanly	862. 03	5. 00	867. 03
Union	719. 90	34. 45	754. 35
Warren	118. 86	1. 73	120. 59
Unknown	976. 78	53. 21	1, 029. 99
Total	$ 93, 650. 30	$ 30, 212. 47	$ 123, 862. 77

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*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

Of this production of gold and silver, $16,740 was obtained from placer mines, of which $16,588 was gold and $152 silver. The value obtained from milling was $56,221, of which $54,987 was due to gold and $1,234 to silver. There was obtained from shipping ores, which were largely copper ores, $21,063 in gold and $28,807 in silver. Dredge mining, which had been carried on to a very limited extent in 1901, was practically abandoned in 1902, and only $21.59 was reported as the value of gold obtained by this method of mining.

In the table that follows there are given the values of the production of gold and silver for the years 1882 to 1902, inclusive:

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1902.*

YEAR.	GOLD.	SILVER.	TOTAL.
1882	$ 190, 000	$ 25, 000	$ 215, 000
1883	167, 000	3, 000	170, 000
1884	157, 000	3, 500	160, 500
1885	152, 000	3, 000	155, 000
1886	175, 000	3, 000	178, 000
1887	225, 000	5, 000	230, 000
1888	136, 000	3, 500	139, 500
1889	145, 000	3, 878	148, 878
1890	118, 500	7, 757	126, 257
1891	95, 000	6, 465	101, 465
1892	78, 560	12, 671	91, 231
1893	53, 600	17, 325	70, 925
1894	46, 594	455	47, 049
1895	54, 200	520	54, 720
1896	44, 300	646	44, 946
1897	34, 600	388	34, 988
1898	84, 000	905	84, 905
1899	34, 500	388	34, 888
1900	44, 653	15, 986	60, 639
1901	60, 410	34, 023	94, 433
1902	93, 650	30, 212	123, 862

* Coining value.

The largest producer of gold during 1902 was the Iola mine, at Candor, Montgomery county. Other mines which were among the more prominent producers in 1902 were the Phoenix mine, in Cabarrus county; the Shuford and England mines, in Catawba county; the Emmons mine, in Davidson county, which is shipping principally copper ore; the Capps, Wilhelmina and Surface Hill mines, in Mecklenburg county; the Holloway and Person Consolidated copper mines, in Person county; and the McMacken and Gold Hill mines, of Rowan county.

Besides the work done at the mines that were producers of gold and silver in 1902, there was a great deal of development work carried on at mines in Cabarrus, Davidson, Mecklenburg, Montgomery, Rowan, Randolph and Union counties, which will undoubtedly result in an increased production of gold and silver in 1903 over that of 1902.

COPPER.

The production of copper in 1902 was confined to Davidson, Rowan, Granville and Person counties, with the largest amount from the latter county. The quantity of ore produced amounted to

16,741 tons, with an estimated value of $212,553, this being an increase of 6,343 tons in quantity and of $135,653 in value over the production of 1901, which was 10,398 tons, valued at $76,900.

This large increase in the production of copper indicates the interest that is becoming centered on the North Carolina deposits. Most of the ore was concentrated, at least to some extent, before being shipped. As was noted under the subject of silver, there is considerable silver obtained as a by-product from nearly all of the copper ores that are mined.

Although there was a great deal of development work done at the copper deposits in Ashe and Jefferson counties, there was no production of copper at any of these deposits. At the Ore Knob mine, Ashe county, a pyritic smelter was erected and blown in, but was immediately shut down and no work has been done with the property since. On account of the distance of this mine from the railroad, it is doubtful whether it will again be in active operation until it has better transportation facilities.

IRON.

There was a decided increase in the production of iron in 1902 over that of 1901, and it amounted to 34,336 tons valued at $52,771. This is an increase of 31,758 tons in quantity and of $47,774 in value over the production of 1901, which was 2,578 tons valued at $4,997. The greater portion of this production was from Mitchell county, with smaller amounts from Johnston and Madison counties.

The blast furnace at Greensboro, N. C., owned by the Empire Steel and Iron Company, was put in operation December 9, 1902, but was blown out December 24th of the same year, having been in blast only two weeks. It is expected, however, that the furnace will be in blast nearly all of the year 1903. This should cause a considerable demand for the iron ores of Johnston and Chatham counties.

ABRASIVES.

Abrasive materials, which are among the most important of the minerals mined, are obtained to some extent in North Carolina. Those that have been mined during recent years in this State are corundum, garnet and millstones. The demand for abrasive materials is constantly on the increase, although there is a considerable variation noted from year to year in the production of the various kinds of abrasives.

CORUNDUM.

There was no production of corundum in North Carolina during 1902, although the deposits of this mineral in the State are the most extensive of any known in the United States, with the exception of the emery deposits of Massachusetts. There was some development work carried on by the North Carolina Corundum Company at Buck Creek, Clay county; and a complete mill for cleaning and sizing the corundum was erected. The company expect to be producers and shippers of this mineral in 1903.

GARNET.

The quantity of garnet produced in North Carolina in 1902 amounted to 260 short tons valued at $10,040 as compared with 775 tons valued at $43,000 produced in 1901, showing a decrease of 510 tons in quantity and of $32,960 in value. The production of garnet is obtained entirely from Jackson county.

MILLSTONES.

Millstones or buhrstones have been manufactured in North Carolina to a limited extent for a great many years for local purposes in the mountain sections of the State, but it is only within the past few years that any attempt was made to produce this stone for commercial purposes. This has now been undertaken by Mr. J. T. Wyatt at Faith, Rowan county, in connection with his other stone business. The production of these stones for 1902 was 50 pairs valued at $1,425, which were sold in North Carolina and Georgia. Where formerly millstones or buhrstones were used in large numbers, principally for grinding wheat, there are now but very few used for this purpose, and it is for grinding the coarser cereals, mineral paint ores, fertilizers, cement rock, barytes and other minerals that is causing an increase in the demand for them. For some of these purposes the stone produced in Rowan county should give good satisfaction.

MICA.

The total production of plate mica in North Carolina during 1902 was 329,466 pounds valued at $81,653, this being an increase of $1,804 in value, as compared with the value of the production of 1901, which was $79,849. The scrap mica produced in 1902 was only 324 tons valued at $2,219, which is a decrease of 1,451 tons in quantity and of $11,281 in value as compared with the production of 1901, which amounted to 1,775 tons valued at $14,200. There has been a constant decrease in the production of scrap mica for the past three or four years, due to the fact that where formerly a large proportion of the scrap mica produced was obtained from old dumps and piles of scrap mica left during the mica mining of twenty years ago, when there was no demand for it; at the present time a large part of the scrap mica produced is that obtained from the present mining. It also to be noticed that there has been a constant increase in the production of sheet or plate mica during this same time, and in the following table there is given the approximate value of the production of this sheet mica by counties for the years 1900, 1901 and 1902.

VALUE OF THE PRODUCTION OF SHEET MICA IN 1900, 1901 AND 1902, BY COUNTIES.

COUNTY.	1900.	1901.	1902.
Buncombe	$----------	$----------	$ 250
Haywood	11,000	11,500	20,000
Jackson	7,000	8,740	5,700
McDowell	1,000	500	600
Macon	5,200	----------	4,000
Mitchell	26,722	33,506	28,203
Stokes	1,000	----------	1,000
Transylvania	500	600	750
Yancey	12,788	25,003	21,150
Total value	$ 65,200	$ 79,849	$ 81,653

As far as can be judged from the mining that is now being carried on and the amount of development work and prospecting that was done in 1902, the production of sheet mica in 1903 should be considerably in excess of that for 1902. There is a constant demand for North Carolina mica, which is increasing, and many orders received for this mica cannot be filled.

QUARTZ.

Although there have been some inquiries during the past year for quartz deposits suitably located so that they could be utilized in the manufacture of pottery, nothing has been done as yet to open up such deposits for this purpose. The only quartz that was mined in 1902 in North Carolina was in Cherokee county, and the entire production was used for flux in the copper smelter at Ducktown, Tennessee. This production amounted to 4,500 tons valued at $11,250, this being an increase of 1,500 tons in quantity and of $3,700 in value as compared with the production of 1901, which was 3,000 tons valued at $7,500.

GEM MINERALS.

The gem minerals of North Carolina, which are of great variety, are obtained principally from Alexander, Burke, Iredell, Lincoln, McDowell, Macon, Mitchell and Yancey counties. The minerals that have been mined during 1902 and classified as gems were rhodolite, pyrope and almandine garnets, various colored beryls, corundum gems, quartz gems, and a number of other minerals which have been sold as mineral specimens. The total value of all the gems produced during 1902 was $5,300, this being a decrease of $18,905 in value as compared with the production of 1901, which was $24,205. The larger proportion of the gems are obtained from Macon county, while Mitchell county is the second largest producer. The gem that was produced in greatest quantity is the rhodolite.

RARE MINERALS.

There was some demand in 1902 for the minerals zircon, uraninite and samarskite, which resulted in a production valued at $420. The larger part of this value was for zircon obtained in Henderson county, and which was used in the manufacture of the glower for the Nernst electric lamp. The samarskite and the uranium minerals, uraninite and gummite, were obtained from Mitchell county. There is a growing demand for the zircon, and considerable interest in the uranium minerals has been aroused from the fact that it is this type of mineral that contains radium.

MONAZITE.

The monazite industry, which was revived in 1898, has continued to grow constantly since that time, and in 1902 the production amounted to 802,000 pounds valued at $64,160. This is an increase of 53,264 pounds in quantity and of $4,898 in value as compared with the production of 1901, which amounted to 748,736 pounds valued at $59,262. The demand for North Carolina monazite is constantly increasing, and during 1902 there were a number of new companies who entered the field to produce this mineral, one of which, the German Monazite Company, expects to export its entire production. Thus the production of 1903 will undoubtedly be much larger than that of 1902. The quantity and value of the production of monazite since 1893 is shown in the following table:

PRODUCTION OF MONAZITE IN NORTH CAROLINA FROM 1893 TO 1902.

YEAR.	POUNDS.	VALUE.
1893	130,000	$ 7,600
1894	546,855	36,193
1895	1,573,000	137,150
1896	30,000	1,500
1897	44,000	1,980
1898	250,776	13,542
1899	350,000	20,000
1900	908,000	48,805
1901	748,736	59,262
1902	802,000	64,160

As is seen from the above table, the quantity of monazite produced in 1900 of 908,000 pounds is greater than for either 1901 or 1902, although the value is less than for either of these years. This is due to the fact that the monazite sand was cleaner and contained a higher percentage of thoria in 1901 and 1902 than in 1900. One concentrating plant has been erected which will clean the monazite sand to such an extent that the refined product contains 95 per cent. or over of monazite. This production of monazite was obtained from Burke, Cleveland, Lincoln, McDowell and Rutherford counties.

BARYTES.

There was a very noticeable increase in the production of barytes in 1902, which was due to the more extensive mining of the deposits of Madison county. The total production of this mineral for 1902 was 14,679 tons valued at $44,130, which is an increase of 7,289 tons in quantity and of $21,515 in value as compared with the production of 7,390 tons valued at $22,615 in 1901. Although this production of 1902 was nearly double that of the previous year, it is expected that there will be a still further increase in the production of 1903, as there is a growing demand for this mineral, due to new uses that have been found for it. The larger part of the 1902 production was from Madison county; the only other county reporting a production was Gaston.

TALC AND PYROPHYLLITE.

There was a falling off in the quantity of talc produced in North Carolina during 1902, although there was an increase in the value, this being due to a smaller quantity of the pyrophyllite variety that was mined and to an increase in the quantity of the higher grades of talc which were capable of being cut into tailors' pencils, etc. The production of these minerals in 1902 amounted to 5,239 short tons valued at $88,962, which shows a decrease of 580 tons in quantity but an increase of $10,988 in value as compared with the production for 1901 of 5,819 tons valued at $77,974. The larger amount of this production was from Swain county, with smaller amounts from Cherokee and Moore counties. The condition in which this talc was marketed is shown in the following table:

TALC PRODUCTS OF NORTH CAROLINA IN 1901 AND 1902.

	1901.		1902.	
	TONS.	VALUE.	TONS.	VALUE.
Ground talc, for powders, etc.	2,864	$29,505	3,381	$ 31,628
Talc cut into pencils, gas tips, etc.	375	26,000	371	42,017
Talc sold crude	2,580	22,319	1,487	15,317
Soapstone cut into slabs for chimneys, etc.		150		
Total	5,819	$77,974	5,239	$ 88,962

GRAPHITE.

The principal graphite deposits in North Carolina are in McDowell and Wake counties, and these were the only ones that made any production in 1902, this amounting to 830 tons valued at $4,300.

This is an increase of 735 tons in quantity and of $3,741 in value as compared with the production of 1901, which was 95 tons valued at $559. A deposit of graphite is being developed in Yancey county about 7 miles east of Burnsville. A graphite mill to treat this ore is to be erected about 17 miles southeast of Burnsville on the headwaters of South Toe river. It is uncertain just when the company will begin to ship this graphite.

COAL.

The production of coal during 1902 in North Carolina was from the Cumnock mines in Chatham county and amounted to 23,000 tons valued at $24,500 as compared with 3,723 tons valued at $5,585 in 1901. This shows an increase in the production of 19,277 tons in quantity and of $23,913 in value.

The quality of the coal is good, and there is a local State market for all this coal that can be produced.

BUILDING STONES.

There was a considerable increase in the total production of building stones in North Carolina in 1902, and the value of this production was $366,727, this being an increase of $81,983 as compared with the value of the total production of 1901, which was $284,744. This increase was due principally to the production of granite. There should be a still greater growth in the building stone industry in North Carolina, for the State is exceptionally well provided with stone suitable for these purposes, which are found abundantly in the middle and western counties, including sandstone, granite, marble, limestone and slate.

SANDSTONE.

The sandstone industry has always been small in North Carolina, although there is sandstone of good quality in Anson, Moore, Chatham, Durham and Wake counties which is extensive and well adapted for building purposes. If sufficient capital would take hold of these quarries and develop them extensively and introduce the stone to the general market, there would undoubtedly arise a considerable demand for it. The production of sandstone in 1902 was principally from Moore county, with a very small amount from Anson. The total value of this production was $4,825, all but $75 of which was used for building purposes. This is a decrease of $6,857 as compared with the production of 1901, which was valued at $11,682.

GRANITE.

The granite industry is the most extensive of any of the building stone industries in the State, and the total value of all the granite produced in 1902 was $338,749, which is an increase of $73,843 as compared with the production for 1901 of $264,906. The number of operators engaged in quarrying granite was 27, who worked at 30 different localities in the following 12 counties: Buncombe, Cabarrus, Catawba, Forsyth, Gaston, Henderson, McDowell, Orange, Rowan, Surry, Vance and Wake. The county of Rowan had the largest number of operators, which was 12, and also made the largest production, which was valued at $122,319. Gaston county, with 5 operators, had the lowest production which was valued at $2,666. Surry county, with but one operator, was second in the value of its production.

Nearly one-half of the granite produced in the State during 1902 was used for building and monumental purposes, which is an increase of $59,065 as compared with the value of the granite used for the same purposes in 1901. In the table below is given the different purposes for which the granite quarried in 1901 and 1902 was used:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901 AND 1902.

USES.	1901.	1902.
Building and monumental purposes	$ 108, 574	$ 167, 639
Paving blocks	10, 662	6, 986
Curbing and flagging	56, 245	82, 615
Crushed stone for road-making, railroad ballast, etc.	89, 425	77, 759
Other purposes		3, 750
Total value	$ 264, 906	$ 338, 749

MARBLE AND LIMESTONE.

There was no production of marble in North Carolina during 1902, although there was some development work carried on by a number of companies organized to quarry this stone in Swain and Cherokee counties. The main difficulty regarding the production of marble in this State has been the distance from the market.

The production of limestone during 1902 was valued at $23,153, which is an increase of $14,796 as compared with the production for 1901, which was valued at $8,356. None of the production was used for building purposes, by far the larger portion being used for making roads. This production of limestone was obtained from Henderson, New Hanover and Pender counties. All of the production of New Hanover county was used for road purposes, and that of the others for burning into lime.

In the following table is shown the uses for which the production of 1901 and 1902 was used:

USES OF LIMESTONE MINED IN 1901 AND 1902.

USES.	1901.	1902.
Building purposes	$ 237. 50	$
Made into lime	3, 688. 00	2, 090. 00
Road materials, curbing, etc.	4, 668. 00	21, 063. 00
Total value	$ 8, 356. 50	$ 23, 153. 00

CLAY.

The total value of all clays and clay products, including kaolin or china clay, pottery clay, fire- and pipe-clay and brick-clay, produced in North Carolina during 1902 was $908,105. This is an increase of $316 as compared with the production of 1901, which was valued at $907,789, and is due to the decrease in the production of kaolin. The value of the clay products in North Carolina, with the exception of kaolin, in 1902 was $800,000, an increase of $11,383 over the production of 1901, which was valued at $788,617. There should be a large increase in the production of clay products in North Carolina, as there are good deposits of clay scattered throughout the State suitable for making a very good brick that will stand transportation, and for the manufacture of earthenware, sewer pipe, etc.

KAOLIN OR CHINA CLAY.

The kaolin produced in North Carolina during 1902 was almost entirely from Jackson county, with small amounts from Swain and

Buncombe, and it amounted to 13,322 tons valued at $108,105. This is a decrease of 3,253 tons in quantity and of $11,066 in value as compared with the production for 1901 of 15,575 tons valued at $119,171.

POTTERY CLAY.

There was a considerable falling off in the production of pottery in North Carolina during 1902, and the total value of this production was only $14,512, which is a decrease of $7,983 as compared with the production of 1901, which was valued at $22,495. There were 26 pottery manufacturers who aided in this production, who were located in 8 counties. There was no decorative ware reported as having been made in 1902, and the production was mostly of stoneware, which was valued at $13,854, the balance of $658 being for earthenware. With improved methods, utilizing more care in the manufacture, and by using better material for glazing the ware, the North Carolina potter would be able to put a far better grade of pottery on the market, with practically no more expense, which would sell at a considerably increased price.

The value of the various grades of pottery produced in the different counties during 1901 and 1902 is given in the table below:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA, BY COUNTIES, IN 1901 AND 1902.

COUNTY.	1901.				1902.		
	Earthenware.	Stoneware.	Decorative Ware, Etc.	Total.	Earthenware.	Stoneware.	Total.
Buncombe	$ 280	$ 3,100	$------	$ 3,320	$150	$ 1,850	$ 2,010
Catawba	----------	2,540	---------	2,540	55	4,410	4,465
Chatham	---------	2,700	---------	2,700	------	2,000	2,000
Cumberland	60	----------	---------	60	------	---------	---------
Johnston	525	1,700	---------	2,225	40	525	565
Lincoln	2,500	2,000	25	4,525	25	2,900	2,925
Randolph	860	3,173	200	4,233	28	769	797
Union	325	1,040	27	1,392	300	300	600
Warren	---------	----------	300	300	------	---------	---------
Wilkes	---------	1,200	---------	1,200	50	1,100	1,150
Total	$ 4,490	$17,453	$ 542	22,495	658	13,854	14,512

As is seen from the above table, Cumberland and Warren counties, which produced pottery in 1901, reported no production in 1902. The four counties reporting a production of decorative ware in 1901 manufactured none of this variety of pottery during 1902.

Fire-clay and Pipe-clay.

The total value of all fire-clay and pipe-clay products reported in 1902 was $74,036. This includes fire-brick, fire-clay, sewer pipe, tile, etc. This is an increase of $16,576 in value as compared with the value of the production of 1901, which was $56,395.

Of the above value, $1,203 was the value of the fire-brick produced, this being an increase of $653 over the value of the production in 1901, which was $550. There was also a small amount of crude fire clay sold in 1902, which was valued at $215.

The value of the production of sewer pipes, tiles, etc., produced in 1902 was $72,618 as compared with $55,745 in 1901. This is an increase of $16,873, but does not begin to represent the increase that there should be in this industry.

Brick-clay.

In the greater number of counties in North Carolina there are clay deposits suitable for the manufacture of brick, and in 1902 brick were manufactured in sixty-seven counties. The total number of all kinds of brick, except fire-brick, made during 1902 was 133,551,700 valued at $711,452, which is an average value of $5.33 per thousand. This is a decrease of 2,164,870 brick, but an increase of $1,722 in value as compared with the production of 1901, which was 135,716,570 brick valued at $709,730. This indicates a better quality of brick manufactured in 1902 than in 1901, and the average price received of $5.33 per thousand is an increase of 10 cents as compared with the average price of $5.23 per thousand received in 1901. The number of manufacturers engaged in making brick during 1902 was 195, which is 36 less than the number engaged in this business in 1901. The lowest value per thousand reported as having been received for brick was $3.75 and the highest $15, this latter value being for a vitrified brick. The highest price reported as having been received for common brick was $8 per thousand, the same price as reported in 1901. In the following table is given the total number and value of the different varieties of brick produced in 1902, by counties:

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1902.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Alamance	5,220,000	$ 24,075	-----	$-----	-----	$-----
Anson	600,000	3,500	-----	-----	-----	-----
Beaufort	1,440,000	9,000	-----	-----	-----	-----
Bertie	3,616,000	18,635	500,000	4,000	-----	-----
Bladen	400,000	2,000	-----	-----	-----	-----
Buncombe	4,750,000	23,978	-----	-----	-----	-----
Burke	1,700,000	6,800	-----	-----	-----	-----
Cabarrus	85,000	425	-----	-----	-----	-----
Caldwell	1,260,000	5,720	-----	-----	-----	-----
Carteret	990,000	500	-----	-----	-----	-----
Catawba	477,000	2,072	-----	-----	-----	-----
Chatham	100,000	500	-----	-----	-----	-----
Chowan	1,000,000	7,000	-----	-----	-----	-----
Cleveland	1,258,000	6,148	-----	-----	-----	-----
Columbus	1,200,000	6,000	-----	-----	-----	-----
Craven	4,500,000	22,500	-----	-----	-----	-----
Cumberland	3,000,000	15,000	-----	-----	-----	-----
Davidson	2,320,000	13,000	-----	-----	-----	-----
Duplin	263,700	1,458	-----	-----	-----	-----
Durham	5,050,000	25,825	-----	-----	-----	-----
Edgecombe	4,050,000	23,500	-----	-----	-----	-----
Forsyth	3,442,000	15,423	-----	-----	-----	-----
Franklin	200,000	1,400	-----	-----	-----	-----
Gaston	1,725,000	7,845	-----	-----	-----	-----
Gates	105,000	430	-----	-----	-----	-----
Granville	800,000	6,000	-----	-----	-----	-----
Greene	910,000	5,478	-----	-----	-----	-----
Guilford	8,802,000	44,160	240,000	1,900	-----	-----
Halifax	4,050,000	23,500	175,000	1,575	-----	-----
Harnett	2,400,000	9,900	-----	-----	-----	-----
Haywood	400,000	2,200	-----	-----	-----	-----
Henderson	1,000,000	6,000	30,000	450	600,000	6,000
Hertford	140,000	880	140,000	880	-----	-----
Iredell	1,500,000	8,050	-----	-----	-----	-----
Johnson	570,000	3,600	-----	-----	-----	-----
Lenoir	3,000,000	18,500	-----	-----	-----	-----
Lincoln	300,000	1,500	-----	-----	-----	-----
McDowell	900,000	5,300	-----	-----	-----	-----
Martin	19,000	105	-----	-----	-----	-----
Mecklenburg	2,765,000	14,418	-----	-----	-----	-----
Montgomery	300,000	1,500	80,000	650	-----	-----
Moore	1,650,000	7,200	-----	-----	-----	-----
Nash	2,000,000	11,000	-----	-----	-----	-----
New Hanover	1,000,000	5,500	-----	-----	-----	-----
Orange	370,000	1,630	-----	-----	-----	-----
Pasquotank	1,650,000	9,575	-----	-----	-----	-----
Person	6,000,000	36,000	-----	-----	-----	-----
Pitt	1,728,000	11,122	-----	-----	-----	-----
Randolph	1,590,000	7,550	-----	-----	-----	-----

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1902—CONTINUED.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Roberson	625,000	$ 3,780		$		$
Rockingham	4,447,000	22,267				
Rowan	1,800,000	10,500				
Rutherford	200,000	850				
Sampson	100,000	500				
Scotland	500,000	2,500				
Stanly	500,000	2,570				
Surry	1,115,000	5,955				
Transylvania	600,000	3,000				
Union	900,000	4,685				
Vance	100,000	700				
Wake	5,215,000	26,573	50,000	450		
Warren	100,000	500				
Washington	160,000	1,100				
Wayne	13,850,000	70,350				
Wilkes	1,325,000	6,380	115,000	690		
Wilson	8,333,000	48,950				
Yadkin	53,000	265	33,000	30		
Total	131,618,700	$ 694,827	1,333,000	$ 10,625	600,000	$ 6,000

As is seen from the above table, of the ninety-seven counties in North Carolina all but thirty reported a production of some variety of brick. In Wayne county were made the greatest number of brick, which amounted to 13,850,000 valued at $70,350. Guilford county is second with a production of 9,042,000 valued at $46,060. The county producing the smallest number of brick was Martin, which reported a production of 19,000 valued at $105.

There is given in the table below the value of all the clay products produced in North Carolina in 1901 and 1902:

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN 1901 AND 1902.

	1901.		1902.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	134, 441, 570	$ 697, 860. 84	131, 611, 700	$ 694, 827. 00
Pressed brick	1, 095, 000	10, 220. 00	1, 233, 000	10, 625. 00
Vitrified brick	180, 000	1, 650. 00	600, 000	6, 000. 00
Fire-brick	550	550. 00		1, 203. 00
Earthenware		4, 490. 00		658. 00
Stoneware		17, 453. 00		13, 854. 00
Decorated ware		552. 00		
Sewer pipe, tile, etc.		55, 745. 05		72, 618. 00
	Tons		Tons	
Kaolin	15, 575	119, 171. 83	13, 322	108, 105. 00
Fire-clay		100. 00		215. 00
Total value		$ 907, 789. 72		$ 908, 105. 00

The above statistics regarding the clay production of the State do not perhaps represent the entire output of clay products, as in a number of the mountain counties a few thousand brick are occasionally made for local purposes, of which it is difficult or impossible to obtain any record.

SUMMARY.

The increase of $223,968 in the total value of the mineral production of the State for 1902 over that of 1901 indicates the growing interest that is taken in the mineral deposits of North Carolina. The above figures are especially significant when it is considered that this increase in the value of the mineral production is exclusive of all clay products. Not only has more value been taken out of the mineral deposits of the State during 1902 than for many years past, but that year has also seen more capital invested in thorough and competent development work than ever before, which will mean a still greater value in the mineral production in the next few years. There are a number of mining propositions throughout the State that are worthy of investigation and the investment of capital. Among these are the clay deposits, which are suitable for the manufacture of pressed brick, fancy brick and pottery. When it is considered that most of these products are now being brought into the State, while there are clay deposits in the State that are suitable for making just as good or better manufactured products than those that are imported, it should be an incentive for capital to invest in this industry. The stone industry is another inviting field for capital, and with the consolidation of a number of the better quarries a large and very prosperous business should be the result. Other propositions are the low-grade gold ores, corundum mines and barytes deposits.

In the following table there is given the total mineral production of the State for the years 1900, 1901 and 1902:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1900, 1901 AND 1902.

MINERAL.	VALUE.		
	1900.	1901.	1902.
Gold	$ 46,653.00	$ 60,410.71	$ 93,650.00
Silver	15,986.00	34,023.64	30,212.00
Copper	41,600.00	76,900.00	212,553.00
Iron	42,000.00	4,997.00	52,771.00
Pyrite	14,625.00	32,000.00	-----
Corundum	36,840.00	48,840.00	-----
Garnet	18,000.00	43,000.00	10,040.00
Mica { Sheet	65,200.00	79,849.00	81,653.00
Mica { Scrap	36,262.00	14,200.00	2,919.00
Quartz	-----	7,500.00	11,250.00
Barytes	-----	22,615.00	44,130.00
Monazite	48,805.00	59,262.00	64,160.00
Talc	42,000.00	77,974.00	88,962.00
Gem minerals, etc.	12,020.00	24,245.00	5,300.00
Rare minerals	-----	-----	420.00
Graphite	-----	559.25	4,300.00
Coal	22,500.00	5,585.00	24,500.00
Building stones	285,172.00	284,744.00	366,727.00
Millstones	-----	-----	1,425.00
Kaolin	62,440.00	119,171.83	108,105.00
Clay products	815,975.00	788,617.89	800,000.00
Total value	$1,604,078.00	$1,779,109.32	$ 2,003,077.00

There were seventy-nine counties out of the ninety-seven in the State from which the mineral production of 1902 was obtained, and in the following table the value of this production for each county is given. The value of the clay products, with the exception of kaolin, which is included with the other minerals, is given separately from the rest of the mineral production, the total value of which is given.

VALUE OF MINERAL PRODUCTION, BY COUNTIES, IN NORTH CAROLINA IN 1901 AND 1902.

County.	1901.			1902.		
	Mineral Production, including Kaolin.	Clay Products except Kaolin.	Total.	Mineral Production, including Kaolin.	Clay Products except Kaolin.	Total.
Alamance	$ 400.00	$ 21,965.00	$ 22,365.00	$	$ 24,075	$ 24,075
Alexander	175.00		175.00	200		200
Alleghany	720.00		720.00			
Anson	1,800.00	3,000.00	4,800.00	4,	250	4,250
Ashe						
Beaufort		10,480.00	10,480.00		9,500	9,500
Bertie		3,162.00	3,162.00		22,653	22,653
Bladen		2,250.00	2,250.00		2,018	2,018
Brunswick						
Buncombe	15.090.01	15,469.85	30,559.86	18,375	27,463	45,838
Burke	24,282.00	4,800.00	29,082 00	10,238	6,800	17,038
Cabarrus	22,426.71	15,250.00	37,676.71	10,650	425	11,076
Caldwell	70.00	6,410.00	6,480.00	19	5,720	5,739
Camden						
Carteret		2,425.00	2,425.00		500	500
Caswell						
Catawba		6,710.00	6,710.00	8,336	6,562	14,898
Chatham	5,585.00	2,700.00	8,285.00	24,630	2,500	27,130
Cherokee	27,500.00		27,500.00	21,952		21,952
Chowan	7,00	0.00	7,000.00	7,	000	7,000
Clay	9,00	0.00	9,000.00	200		200
Cleveland	17,532.00	8,100.00	25,632.00	16,000	6,148	22,148
Columbus		12,450.00	12,450.00		6,000	6,000
Craven		16,750.00	16,750.00		22,500	22,500
Cumberland		7,560.00	7,560.00	19	15,000	15,019
Currituck						
Dare						
Davidson	2,500.00	7,400.00	7,400.00	27,971	13,000	40,971
Davie	15,00	0.00	15,000.00			
Duplin		1,306.00	1,306.00		1,458	1,458
Durham		40,275.00	40,275.00		25,825	25,825
Edgecombe		20,270.00	20,270.00		23,500	23,500
Forsyth	3,906.00	48,206.00	52,112.00	3,057	15,623	18,680
Franklin		3,500.00	3,500.00	632	1,400	2,032
Gaston	42,279.50	15,630.00	57,909.50	8,874	7,845	16,719
Gates		425.00	425.00		430	430
Graham						
Granville		6,250.00	6,250.00	3,996	6,000	9,996
Greene		6,653.48	6,653.48		5,478	5,478
Guilford		110,974.00	110,974.00	966	117,560	118,526
Halifax		13,460.00	13,460.00	1,356	25,075	26,431
Harnett		5,600.00	5,600.00		9,900	9,900
Haywood	13,124.00	2,500.00	15,624.00	20,850	2,200	23,050
Henderson	13,169.43	14,325.00	27,494.43	16,201	12,450	28,651
Hertford					1,760	1,760
Hyde						
Iredell	70.00	8,885.00	8,955.00	434	8,050	8,484
Jackson	163,641.93	18.00	163,659.00	119,905		119,905
Johnston		10,575.00	10,575.00	475	4,165	4,640
Jones						
Lenoir		13,000.00	13,000.00		18,500	18,500
Lincoln	100.00	6,275.00	6.375.00	9,845	4,425	14,270
McDowell	37,074.00	6,300.00	43,374.00	42,715	5,300	48,015
Macon	58,180.00		58,180.00	6,344		6.344
Madison	14,795.00		14,795.00	42,630		42,630
Martin		325.00	325.00		105	105
Mecklenburg	32,149.00	41,062.00	73,211.00	21,300	14,418	35,718
Mitchell	42,835.06		42,835.00	79,319		79,319
Montgomery	2,000.00	200.00	2,200.00	39,173	2,150	41,323
Moore	18,796.00	10,220.00	29,016.00	13,937	7,200	21,137
Nash	100.00	24,100.00	24,200.00	299	11,000	11,299
New Hanover	4,668.00	3,000.00	7,668.00	21,063	5,500	26,563
Northampton						
Onslow						
Orange		4,345.00	4,345.00	5,462	1,648	7,110
Pamlico						
Pasquotank		10,450.00	10,450.00		9,575	9,575
Pender	600.00		600.00	470		470

VALUE OF MINERAL PRODUCTION, BY COUNTIES, IN NORTH CAROLINA IN 1901 AND 1902—CONTINUED.

COUNTY.	1901.			1902.		
	Mineral Production, including Kaolin.	Clay Products except Kaolin.	Total.	Mineral Production, including Kaolin.	Clay Products except Kaolin.	Total.
Perquimans	$----------	$----------	----------	$----------	$----------	$----------
Person	47,000.00	3,000.00	50,000.00	157,010	36,000	193,010
Pitt	----------	1,794.73	1,794.73	----------	11,122	11,122
Polk	300.00	----------	300.00	1,339	----------	1,339
Randolph	20,165.00	7,377.02	27,542.02	1,076	8,547	9,623
Richmond	----------	----------	----------	----------	----------	----------
Robeson	----------	8,689.00	8,689.00	----------	3,780	3,780
Rockingham	----------	3,850 00	3,850.00	----------	22,267	22,267
Rowan	126,438.15	18,400.00	144,838.15	187,777	10,500	198,277
Rutherford	8,989.64	7,783.00	16,772.64	18,269	850	19,119
Sampson	----------	9,100.00	9,100.00	----------	500	500
Scotland	----------	5,000.00	5,000.00	----------	2,500	2,500
Stanly	2,660.16	2,000.00	4,660.16	867	2,570	3,437
Stokes	----------	----------	----------	1,000	----------	1,000
Surry	88,654.00		88,654.00	116,965		116,965
Swain	40,115.00	----------	40,115.00	74,187	----------	70,187
Transylvania	1,440.00	875.00	2,315.00	780	3,100	3,880
Tyrrell	----------	----------	----------	----------	----------	----------
Union	----------	12,807.00	12,807.00	754	5,285	6,039
Vance	18,700.00	700.00	19,400.00	17,554	700	18,254
Wake	21,034.25	22,357 31	43,391.56	9,200	27,023	36,223
Warren	----------	1,050.00	1,050.00	121	500	621
Washington	----------	1,800.00	1,800.00	----------	1,100	1,100
Watauga	----------	----------	----------	----------	----------	----------
Wayne	----------	39,450.00	39,450.00	----------	70,350	70,350
Wilkes	----------	5,465.00	5,465.00	----------	8,220	8,220
Wilson	----------	17,700.00	17,700.00	----------	48,950	48,950
Yadkin	----------	315.00	315.00	----------	295	295
Yancey	33,995.00	----------	33,995.00	22,159	----------	22,159
Unknown	----------	----------	----------	1,030	----------	1,030
Total value	$ 990,491.43	$ 788,617.89	$ 1,779,109.32	$ 1,203,077	$ 800,000	$ 2,003,077

Of the seventy-nine counties reporting a mineral production for 1902 there were only fifty-one counties that reported anything besides clay products. There were sixty-six counties reporting a production of clay, of which twenty-eight counties did not report any other mineral production. There were nine counties which reported a mineral production, but none of clay products. The number of counties producing both clay and other mineral products was forty-two. There were eighteen counties that did not report the production of any mineral whatever during 1902. The county the value of whose mineral production (except clay products) was greatest was Rowan, the value being $187,777. The county producing the greatest value of clay products was Guilford, the value of which was $117,560. The county whose total mineral production was greatest in 1902 was Rowan, the value of the production being $198,277. Person county is a close second, with a production valued at $193,010. The lowest value reported by any county was $105, which was the value of the mineral production of Martin county.

BULLETINS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper No. 8

THE MINING INDUSTRY

IN

NORTH CAROLINA DURING 1903

BY

JOSEPH HYDE PRATT, Ph.D.
MINERALOGIST

MAY 20 1775

RALEIGH
E. M. Uzzell & Co., Public Printers and Binders
1904

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North Carolina
State Library.

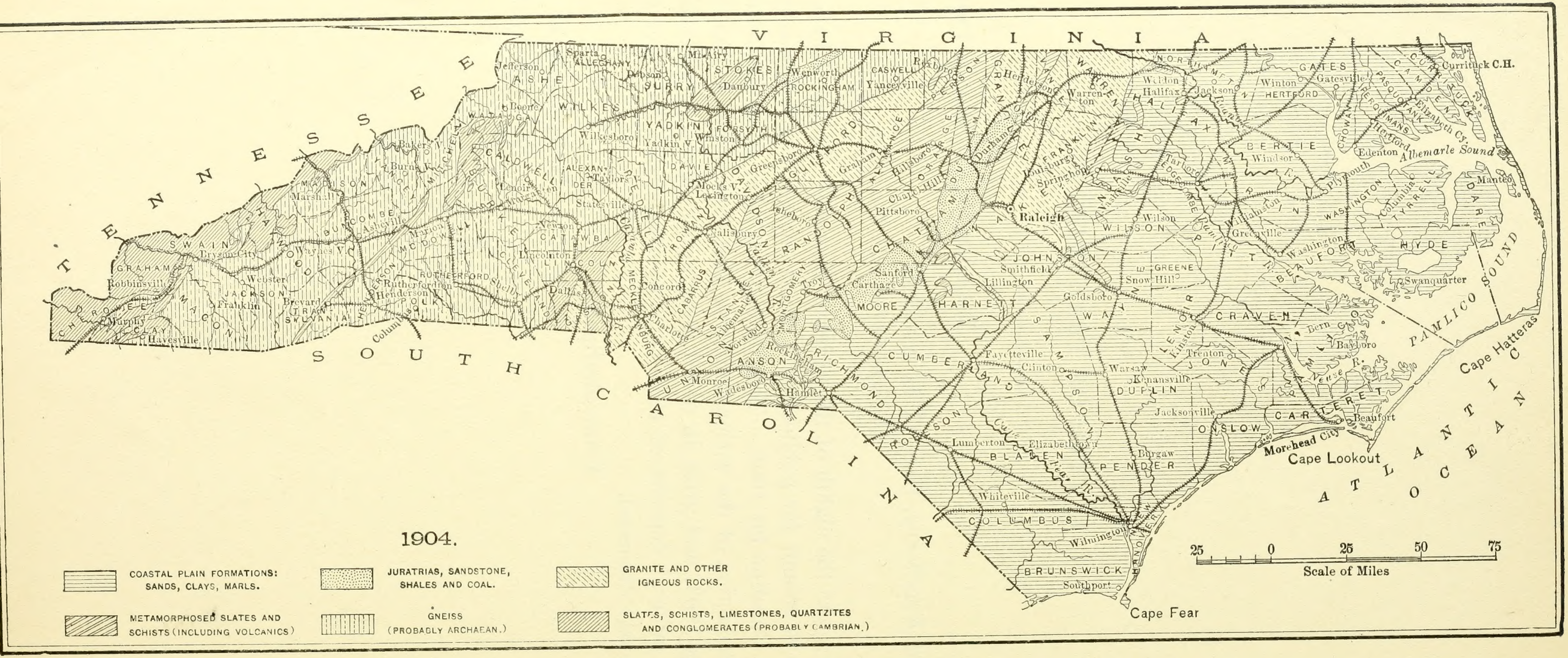
LETTER OF TRANSMITTAL.

Raleigh, N. C., May 1, 1904.

To His Excellency, Hon. C. B. Aycock,
Governor of North Carolina.

Sir:—As the eighth of the series of Economic Papers, I have the honor to submit for publication a report on the *Mining Industry* in North Carolina for 1903. This publication takes up the statistics of the production of the various minerals that were mined in the State during 1903, and gives in detail descriptions of the occurrences of those mineral deposits of economic importance that have not been previously discussed.

Yours obediently,
J. A. Holmes,
State Geologist.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S O U T H   C A R O L I N A
A T L A N T I C   O C E A N
Albemarle Sound
PAMLICO SOUND
Currituck C.H.
Manteo
Cape Hatteras
Cape Lookout
Cape Fear
Morehead City
Beaufort
Wilmington
Southport
Raleigh
Greensboro
Charlotte
Asheville
Fayetteville
Goldsboro
Durham
Winston
Salisbury
Statesville
1904.
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN.)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN.)
25
0
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Scale of Miles

Map of North Carolina Showing the Distribution of the Principal Geological Formations.

MINING INDUSTRY IN NORTH CAROLINA DURING 1903.

By JOSEPH HYDE PRATT.

INTRODUCTION.

The mineral production of North Carolina during 1903 was somewhat smaller than that of 1902, although there was a decidedly progressive and substantial development of the mineral properties in the State. This is shown more especially in the development of the gold and copper properties, many of which, though not producing any metal in 1903, are in a condition to become producers during 1904. There was a decided increase in the production of iron ores, but a falling off in the production of talc and kaolin; not due, however, to the lack of demand for these latter two minerals, but to the scarcity of the supply.

There has been a continual increase in the quantity and value of the production of clay products for a number of years and during 1903 there was a considerable increase in this production. Thus, at the present time, the total value of the production of clay products and kaolin is practically one-half of the total mineral production of the State.

The deposits that are attracting perhaps more attention than any other are the gold ores of the State; and, while there was some increase in the production of gold in 1903 over that of 1902, it may be confidently expected from the amount of systematic development work that has been carried on during the past year that there will be a much larger increase in the value of the production during 1904. This work has been applied largely to the development and re-opening of old deposits.

Another metal that is attracting considerable attention is tin, and the deposits of cassiterite, the ore of tin, in Gaston County are being prospected and developed very vigorously.

The aggregate value of the mineral production in North Carolina during 1903 was $1,902,485 as compared with $2,003,077, the value of the total production in 1902, which is a decrease of $100,592. As compared with the value of the production of 1901, which was $1,779,109, this is an increase of $123,376. The minerals and ores that have been mined and have added to the production of mineral products in North Carolina in 1903 are given below in the order in which they are discussed in the following pages: Gold and Silver, Copper, Iron, Corundum, Garnet, Millstones, Mica, Quartz, Barytes, Monazite, Talc and Pyrophyllite, Precious Stones, Rare Earth Minerals, Graphite, Coal, Stone, Kaolin and Clay Products.

GOLD AND SILVER.

The area in North Carolina in which gold and silver deposits are known to occur embraces from 8,000 to 10,000 square miles of the middle and western counties. In this area there are over 400 localities in the State that have been mined for gold and silver. In 1903 there were 31 counties that added to the production of these metals. In some the gold was obtained as a by-product in placer mining for other minerals, such as monazite, and in other cases was obtained in development work or prospecting and amounted to but a few ounces of these metals. There has been a large amount of systematic development work carried on at many localities throughout the State on properties that have not been producers for many years, and a number of these are now in a condition so that they will be producers of these metals in 1904. Many of the properties that were producers in 1902 largely increased their production in 1903, and have enlarged their mills and reduction plants so as to be able to treat a greater output of ore during the next year. Experimental work has been carried on to some extent to determine the feasibility of treating many of the sulphide ores in the State by the cyanide process, and at the Colossus mine (formerly the Howie mine) in Union County, such ores are being successfully treated.

MINES PRODUCING GOLD AND SILVER IN 1903.

In 1903 there were 37 properties that could be designated as working mines that made a production of gold and silver. These were located in 17 different counties. In the table below there is given a list of these mines and the counties in which they are located:

MINES IN NORTH CAROLINA PRODUCING GOLD IN 1903.

NAME OF MINE.	COUNTY.	NAME OF MINE.	COUNTY.
Boger	Cabarrus.	Alden & Merrill	Moore.
Miami (formerly Phœnix)	Cabarrus.	Mann-Arrington	Nash.
Shuford	Catawba.	Holloway*	Person.
M. Ramsay	Cherokee.	Tingen*	Person.
Norlina	Davidson.	Yancey*	Person.
Blue Wing*	Granville.	Lilian	Polk.
Portis	Franklin.	Cid	Randolph.
Deep River	Guilford.	Sawyer or Stillwater	Randolph.
Fentress	Guilford.	Gold Hill*	Rowan.
Gardner	Guilford.	Whitney (formerly McMakin)	Rowan.
Lindsay	Guilford.	Union*	Rowan.
McCullough	Guilford.	Barringer	Stanly.
Capps Hill	Mecklenburg.	Ingram or Crawford	Stanly.
Surface Hill	Mecklenburg.	Parker	Stanly.
Summerville or Wilhelmina	Mecklenburg.	Colossus (formerly Howie)	Union.
Vein Mountain	Mecklenburg.	Indian Trail (formerly Black)	Union.
Iola	Montgomery.	Moore	Union.
Montgomery	Montgomery.		
Russell	Montgomery.		

Of the above mines, those marked with an asterisk are copper mines, from the ores of which, however, there is obtained more or less silver and gold as by-products. It might be stated here that nearly all of the silver obtained in North Carolina is as a by-product from the copper mines. The gold is very free from silver, as is indicated by the table on page 17, which gives the production of gold and silver by counties for the year 1903.

In Cabarrus County the Miami Mining Company have been carrying on extensive development work at the Phoenix mine up to January, 1904, this property having been opened up by means of five shafts, six drifts and cross-cuts amounting to 3,932 feet. The deepest shaft is the Old Phoenix, which has been sunk to a depth of 604 feet with 547 feet of drifts on the 150-ft. level; 404 feet of drifts on the 250-ft. level; 594 feet of drifts on the 350-ft. level, and 489 feet of drifts on the lowest or 420-ft. level. From the 420-ft. level a winze 15 feet deep has been sunk and on the 350-ft. level there are a few short cross-cuts. The next deepest shaft on the property is the Furniss, which is 170 feet deep with 140 feet of drifts on the 100-ft. level and 204 feet of drifts on the 170-ft. level, which also has 84 feet of cross-cuts. The total underground workings of the Phoenix mine are as follows:

UNDER-GROUND WORKINGS OF PHOENIX MINE.

NAME OF SHAFT.	NUMBER OF FEET.			TOTAL.
	SHAFTS.	DRIFTS.	CROSS-CUTS.	
Phoenix	101	45	6	152
Junction	70		63	133
Copper	150	234		384
Old Phoenix	604	2, 034	27*	2, 665
Furniss	170	344	84	598
Total	1, 095	2, 657	180	3, 932

*Includes a 15′ winze on 420′ level.

The working shafts are double compartments, each measuring 4x4 feet. It is estimated that there are about 35,000 tons of ore blocked out in this mine, the vein averaging 16 inches in width. The mine is equipped with a 10-stamp mill, each stamp weighing 1,050 pounds, and Bartlett concentrating tables. The tailings are cyanided.

While this property produced but little gold in 1903, it is expected that during 1904 it will add considerably to North Carolina's production of this metal.

The North Carolina Mining and Milling Company have been developing a property in Cabarrus County about 4 miles southeast of Concord and 2½ miles north of the Phoenix mine. There has been about 130 feet of shafting sunk on the vein during the development work, but not sufficient work has as yet been done to determine the actual value of the property or to warrant the erection of a mill.

In the Lytton Mining District, near Lytton, Tabernacle Township, Randolph County, North Carolina, there are a number of properties that have been opened up during the past year. Some of these are new ones that have never before been developed, while others are old mines that have been re-opened. The Southern Homestake Gold Mining Company is operating a free milling ore that occurs as parallel bands in a schistose rock, and one of these veins has been opened by a series of open cuts across the vein for a distance of 12,000 feet along the strike. This is a low-grade ore, averaging from $3 to $5 per ton, and this company expect to erect a cyanide plant to recover the values. A few prospect shafts or pits have been sunk on the vein for a depth of 25 to 50 feet. On the Senter gold mining property there are two similar veins or bands of gold-bearing schistose rock that have been opened for a distance of about 4,000 feet along the strike by means of open cuts, pits and short drifts. The width of this gold-bearing strata varies from 100 to 300 feet. The deepest work that has been done is the sinking of one shaft to 70 feet. This property would be another of those that could be worked by open cuts for some years. The Empire gold mining property has the same character of ore and has been developed by means of open cuts and pits. Other properties, in this same district, that contain deposits of a similar character and that have been opened up during the past year are those of the Pierce Mountain Gold Mining Company; the Miller Gold Mining Company; the Jones Gold Mining Company, and the Cameron Mountain Gold Mining Company, the latter adjoining the Southern Homestake Mining Company's property. The Cameron Mountain property has been opened to a depth of 125 feet. All these properties contain low-grade ores and, as sampled by various engineers, have given values ranging something as follows: $2.50, $3.90, $4.80 and $5.10 per ton. In former years these ores have been worked to some extent by means of Chilian mills; but it is the intention of those now owning these properties to treat them by cyaniding.

Another mine in Randolph County that has been re-opened during the past year is the Parrish mine, and the result of the development work carried on has been the opening up of a vein 3½ feet wide, which is composed almost entirely of actinolite. As far as opened, the ore is free milling and gave on assaying values ranging from $20 to $30 per ton. The vein has been opened to a depth of about 30 feet.

The Whitney Company of Salisbury, North Carolina, is actively developing the Barringer mine in Stanly County and the McMakin mine in Rowan County. During the year 1903 there was 450 feet of new drifts made at the McMakin mine, Gold Hill, Rowan County, making, up to January, 1904, a total of 7,712 feet of development work that has been done at this mine, divided as follows: Shafts, 1,621 feet; drifts, 3,635 feet; cross-cuts, 2,456 feet. The deepest shaft on this property is now nearly 700 feet. The property is equipped with a 10-stamp mill that operated during 1903 on ore from this mine averaging from $10 to $30 per ton.

The Barringer mine, which is 1 mile southwest of Gladstone, Stanly County, was developed in 1903 to the extent of 150 feet of shafts, 395 feet of drifts and 92 feet of cross-cuts. This makes the total amount of under-ground work to January, 1904, 1,060 feet, of which 204 feet were shafts, 681 feet drifts, and 175 feet of cross-cuts. The ore mined was treated at the mill of the McMakin mine. The deepest shaft on this property is now 175 feet. Both of these mines were producers of gold in 1903.

Besides these properties, the Whitney Company own the Yadkin and Virgilina Copper and Land Company, which is an organization resulting from the merger of a number of mineral properties located in the neighborhood of Virgilina, Virginia. The Yadkin Mines Consolidated Company was formed by the merger of the Old Russell mine and a number of adjoining properties located in Montgomery County. No work of any particular importance was done upon these properties during 1903, and it is the intention of the Whitney Company to postpone any active developments on these properties until the large operations that are being undertaken by this company at the Narrows of the Yadkin river are fully completed. As soon as the installation of the electric power plant is finished at the Narrows of the Yadkin, extensive development work and mining operations will be carried on by this company at their numerous properties in the surrounding districts of North Carolina.

The mine producing the most gold during 1903 was the Iola in Montgomery County. This mine is owned by the Iola Mining Company, who own a tract of land containing some 52 acres, which is located 2 miles northwest of Candor, a station on the railroad running from Ashboro to Aberdeen. The property has been opened by means of two shafts, one at an inclination of 45 degrees following the dip of the vein whose strike is N. E.-S. W. This shaft has been sunk 173 feet and from it five levels have been started. The second shaft is a vertical one and was started 225 feet from shaft number one. It has been sunk to a depth of 200 feet. At the 150-ft. level a cross-cut has been made to the vein connecting with the drifts from shaft number one. The length of this cross-cut is 110 feet. This shaft will encounter the vein, if it holds its present dip, at a depth of 275 feet. The mine is equipped with a 20-stamp mill and amalgamating tables. A cyanide plant has been installed to treat the tailings and works satisfactorily. It has been estimated that there has been about $165,000 in gold taken from this mine.

The Oak Hill Mine, near High Point, Guilford County, was developed during 1903 by the Oak Hill Mining Company with satisfactory results. While there has been thus far no shipment of ore or concentrates, it is expected that this mine will be one of the producers of gold in 1904.

The Enterprise Gold Mining, Milling and Investment Company is developing a property within a few miles of Burlington, Alamance County.

The Nibelong mine in Caldwell County, 11 miles north of Morganton, Burke County, and owned by the Blue Ridge Mining and Milling Company, was developed during the latter part of 1903 to the extent of sinking one shaft 75 feet deep, at which level one drift was run 60 feet to the northeast and another 55 feet to the southwest. The vein averages about 2 feet in width. The property is equipped with a 5-stamp mill.

The Nor-Lin Mining Company, which is developing a property near Silver Hill, Davidson County, North Carolina, is erecting a small stamp mill and other necessary equipment for treating the ore.

At the Colossus mine, which was formerly the Howie mine in Union County, the ore is being successfully treated by cyaniding and is proving satisfactorily that North Carolina's low-grade ores are susceptible to cyanide treatment.

From the amount of development work that is being carried on in the State on gold properties, as is indicated from what has been said above, there is every reason for expecting a large increase in the production of gold in North Carolina during 1904 over that of the previous year.

PRODUCTION.

The total production of gold and silver in 1903 was valued at $130,511 (coining value), which is an increase of $6,649 over that of 1902, which was valued at $123,862. Of this production, the value of the gold was $113,604, an increase of $19,954 over that of 1902, which was valued at $93,650. The value of the production of silver in 1903 of $16,907 (coining value) was a decrease of $13,305 as compared with the value of the production of 1902, which amounted to $30,212. This large reduction in the value of the silver production is due to the large falling off in the production of copper ores, as nearly all the silver is obtained from these ores.

The 1903 production of gold and silver was divided among 31 counties. The county producing the largest amount of gold was Montgomery with a production valued at $48,635; while the smallest production was from Caldwell County, which is credited with a production valued at $41.10. The county which was second in the production of gold during 1903 was Stanly with a production valued at $24,524; while Mecklenburg was third with a production valued at $8,578. The production of silver was obtained principally from Person, Rowan and Granville Counties, from which was also obtained nearly all of the copper produced in 1903. Person County, which produced the largest amount of copper, also produced the largest amount of silver, this being valued at $8,632. Rowan County was second with a production valued at $4,119 and Granville County third with a production valued at $2,259. The combined value of the production of silver in these three counties is $15,010; while the total value of all the silver produced in 1903 was only $16,906, leaving but a value of $1,896 as having been obtained from gold ores. This indicates the fineness of the gold that is mined in North Carolina. In the tables below there is given the production of gold and silver in North Carolina during 1903 and 1902 by counties:

PRODUCTION OF GOLD AND SILVER IN 1903 BY COUNTIES.*

COUNTY.	GOLD.†	SILVER.†	TOTAL.
Burke	$ 1,606.44	$ 17.09	$ 1,623.53
Cabarrus	3,237.23	85.93	3,323.16
Caldwell	41.10	.87	41.97
Catawba	1,181.07	19.09	1,200.16
Cherokee	1,144.52	5.91	1,150.43
Clay	46.51	.29	46.80
Cleveland	5,269.40	1.16	5,270.56
Davidson	230.12	161.52	391.64
Franklin	162.79	2.48	165.27
Gaston	196.84	2.85	199.69
Granville	562.68	2,258.97	2,821.65
Guilford	3,806.62	159.16	3,965.78
Halifax	423.81	2.63	426.44
Henderson	186.05	2.33	188.38
Iredell	133.84	1.60	135.44
Lincoln	522.42	9.90	532.32
Macon	93.02	.58	93.60
McDowell	2,260.15	30.60	2,290.75
Mecklenburg	8,578.72	102.89	8,681.61
Montgomery	48,634.83	878.27	49,513.10
Moore	388.87	8.04	396.91
Nash	139.54	2.15	141.69
Orange	351.46	5.11	356.57
Person	1,096.15	8,632.24	9,728.39
Polk	602.21	4.22	606.43
Randolph	396.30	6.96	403.26
Rowan	1,852.39	4,119.21	5,971.60
Rutherford	1,322.20	16.91	1,339.01
Stanly	24,524.30	116.05	24,640.35
Union	3,101.84	95.68	3,197.52
Warren	139.54	1.75	141.29
Unknown	1,370.59	154.22	1,524.81
Total	$113,603.55	$ 16,906.66	$ 130,510.11

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*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

PRODUCTION OF GOLD AND SILVER IN 1902 BY COUNTIES.*

COUNTY.	GOLD.†	SILVER.†	TOTAL.
Burke	$ 3,536.19	$ 42.07	$ 3,578.26
Cabarrus	1,049.30	87.20	1,136.50
Caldwell	18.60	.11	18.71
Catawba	1,544.93	15.97	1,560.90
Chatham	127.76	2.55	130.31
Cherokee	1,221.86	5.67	1,227.53
Clay	198.14	1.41	199.55
Cumberland	18.60	.11	18.71
Davidson	603.24	367.77	971.01
Franklin	625.77	6.24	632.01
Gaston	205.30	3.19	208.49
Granville	253.23	937.75	1,190.98
Guilford	929.45	36.57	966.02
Halifax	1,350.56	5.14	1,355.70
Henderson	490.19	10.63	500.82
Iredell	231.61	2.89	234.50
Lincoln	144.74	.54	145.28
Macon	93.02	.58	93.60
McDowell	2,048.85	36.63	2,085.48
Mecklenburg	20,439.58	860.41	21,299.99
Montgomery	38,498.15	675.00	39,173.15
Moore	542.75	19.55	562.30
Nash	292.24	6.79	299.03
Orange	504.70	18.71	523.41
Person	1,241.47	10,520.50	11,761.97
Polk	1,325.70	12.98	1,338.68
Randolph	1,064.48	11.30	1,075.78
Rowan	10,131.17	16,401.86	26,533.03
Rutherford	2,241.15	27.96	2,269.11
Stanly	862.03	5.00	867.03
Union	719.90	34.45	754.35
Warren	118.86	1.73	120.59
Unknown	976.78	53.21	1,029.99
Total	$ 93,650.30	$ 30,212.47	$ 123,862.77

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*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

As is seen from the above tables, Chatham and Cumberland counties, which made a small production of gold and silver in 1902, were not producers in 1903. Cleveland County was added to the list of producers in 1903, and is fourth in the value of its production of gold and fifth in the value of its combined production of gold and silver.

The production of gold in North Carolina since 1882 is given in the table below:

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1903.*

YEAR.	GOLD.	SILVER.	TOTAL.
1882	$ 190,000	$ 25,000	$ 215,000
1883	167,000	3,000	170,000
1884	157,000	3,500	160,500
1885	152,000	3,000	155,000
1886	175,000	3,000	178,000
1887	225,000	5,000	230,000
1888	136,000	3,500	139,500
1889	145,000	3,878	148,878
1890	118,500	7,757	126,257
1891	95,000	6,465	101,465
1892	78,560	12,671	91,231
1893	53,600	17,325	70,925
1894	46,594	455	47,049
1895	54,200	520	54,720
1896	44,300	646	44,946
1897	34,600	388	34,988
1989	84,000	905	84,905
1890	34,500	388	34,888
1890	44,653	15,986	60,639
1901	60,410	34,023	94,433
1902	93,650	30,212	123,862
1903	113,604	16,907	130,511

*Coining value.

COPPER.

The production of copper ores in North Carolina in 1903 was considerably less than for the year previous, but there was, on the other hand, a considerable increase in the amount of development work that was carried on, which cannot but result favorably to the production of these ores during the next few years. The copper mine that has been worked the most extensively in the State was closed down during 1903 and the under-ground workings allowed to cave. This was the Holloway mine, which has been worked continuously from

1897 to 1904. During this period it has produced 16,695 tons of ore, from which there were obtained 1,613,550 pounds of copper, or 4.31 per cent. of copper to the ton of ore.

The Virgilina or Blue Wing District of Granville and Person counties was the scene of considerable mining and development work during 1903, and this district produced more copper than any other district in the State. The largest producer of copper in the district during 1903 was the old Yancey mine owned by the Person Consolidated Copper and Gold Mining Company, which is located about eight miles nearly south of Virgilina. This deposit is on a vein that is approximately parallel to the one on which is located the Holloway mine.

In this same district is the property of the Seaboard Copper Company, which is in Person County about 6 miles from Roxboro. This property has been developed by means of three shafts, 135, 200 and 105 feet deep respectively. From the 100-ft. level of the 200-ft. shaft, a drift 165 feet long has been driven, which connects with the 135-ft. shaft. On the 200-ft. level another drift is being driven to connect with the 135-ft. shaft, as this is sunk deeper. At the 100-ft. level of the 105-ft. shaft a drift has been started. It is estimated that there are on the surface about 1,200 tons of ore which will average approximately 6 per cent. copper.

The Salisbury Copper Company has re-opened what is known as the Holshouser mine, which is located near Crescent, Rowan County; about a mile from the Yadkin Railroad. A 5x10 vertical shaft is being sunk on the vein, and from it at a depth of 40 feet a cross-cut was driven across the vein which had a width of 15 feet. The vein is composed principally of quartz with auriferous copper and iron pyrites.

At the Gold Hill Copper mines, Rowan County, of which the Union Copper mine is the most extensively developed, there was but little work done during 1903, so that the production of copper and silver from this district was much less than during the previous year.

The Hercules Gold and Copper Company, whose property is at Cid, Davidson County, have been doing, during the past two years, as systematic development work as any other company in the State.

In this district the company own about 1,000 acres in fee-simple and have leased about 1,200 more. The copper deposit has been opened by means of 5 shafts which are approximately 40, 120, 180, 375 and 525 feet in depth respectively. Drifts have been driven at a number of levels from the shafts and a number of these are connected with each other. In carrying on this work as little ore as possible has been removed from the mine, and there has only been between 5,000 and 6,000 tons of ore raised to the surface. This is now on the dumps and will probably average 5 per cent. copper and about $2 per ton in gold. The mine is equipped with a 50-ton water-jacket smelter and a concentrating mill. While this company made practically no production of copper in 1903, except what little was used for testing the value of the ore, they will, undoubtedly, during 1904, be added to the list of producers of both gold and copper in North Carolina.

The Twin-Edwards copper mine is in Guilford County, about one-half mile southwest of Greensboro and within one mile of the main line of the Southern Railway near Pomona. This property has not been worked since 1861, but during the past year it has been re-opened and some promising results as to the quantity of ore have been obtained. A sample of this ore, which was assayed at the laboratory of the Survey, gave the following results:

ASSAY OF ORE FROM TWIN-EDWARDS MINE.

	PER TON.	VALUE PER TON.
Gold	.343 oz.	$ 6.86
Silver	Trace	
Copper	.8790	1.74

At the Everett mine, which is about 1½ miles from Medlin P. O. and 1½ miles from the junction of Sugar Fork creek and Hazel creek, no work was done during 1903 on account of litigation. This property has been systematically prospected and preparations were being made for the erection of reduction works for treating the ore, which will undoubtedly be completed as soon as the lawsuit is settled. In the upper workings of this mine some native copper and considerable tenorite, the black oxide of copper, have been found. From one drift about 20 tons of this oxide of copper were taken out. It has been estimated that there are between 8,000 and 9,000 tons of ore on the dumps that were taken out during the development work. The property is equipped with four Rand drills, compressors, engines, boilers, etc., and all necessary tools for the employment of 125 men. Near the Everett mine on Hazel creek the Westfeldt Brothers of New Orleans are systematically developing a copper property to block out a certain tonnage of ore. The ore body carries from 4 to 5 per cent. copper, with some values in gold and silver.

There was a small amount of development work done in Jackson County on the properties of the Carolina Copper Company and the Cullowhee Copper Company in the central part of the county near Cullowhee, North Carolina. There was no production of copper, however, and the properties are still in the nature of prospects.

There was no work whatever done in the Ore Knob Copper District of Ashe County or the Peach Bottom Copper District of Alleghany. One of the main difficulties of operating these copper deposits in Alleghany and Ashe counties is their distance from railroad transportation as well as their distance from fuel.

PRODUCTION.

The total production of copper in 1903 was 438,133 pounds, valued at $67,037. This is less than one-third the production of 1902, which amounted to 1,417,020 pounds, valued at $212,553. This is also a decrease of 54,533 pounds in quantity and of $9,863 in value as compared with the production of 512,666 pounds, valued at $76,900, in 1901. The total tonnage of crude ore mined in 1903, from which the 438,133 pounds of metallic copper were obtained, was 4,106 tons. This ore contained from 3 to 27 per cent. of copper and a large part of it was concentrated before shipment.

Considering the amount of development work that was done in 1903, there should be a considerable increase in the production of copper in 1904 over that of 1903. In the following table there is given the production of copper for the years 1901, 1902 and 1903:

PRODUCTION OF COPPER IN NORTH CAROLINA IN 1901, 1902 AND 1903.

YEAR.	CRUDE ORE MINED.	COPPER PRODUCED.	VALUE.
	TONS.	POUNDS.	
1901	10, 398	512, 666	$ 76, 900
1902	16, 741	1, 417, 020	212, 553
1903	4, 106	458, 133	67, 037

IRON.

The iron deposits of North Carolina were worked more extensively during 1903 than for many previous years. The Cranberry mine, at Cranberry, Mitchell County, owned by the Cranberry Furnace Company, continues to be the largest producer of iron ore. This mine, which furnishes magnetic iron ore, is the most famous mine in the State and has been the only constant producer of iron ore. It furnishes a pig iron of superior quality.

The Wilson mine, at Wilson's Mills, Johnston County, was worked almost continuously for the first six months of 1903; but then, owing to the shutting down of the Greensboro furnaces, the mine also was obliged to close down. The ore obtained from this mine is a limonite containing, according to the analyses of the average run of ore, as follows:

COMMERCIAL ANALYSES OF LIMONITE ORE FROM WILSON MINE.

Metallic iron	49 to 51 per cent.
Phosphorus	. 3 to . 55 per cent.
Sulphur	None.
Manganese	Trace to . 3 per cent.
Silica	4 to 18 per cent.

The body of ore is apparently large, and if the smelter at Greensboro should again start up this mine would undoubtedly once more become a producer of iron ore.

There was no production of iron ore from the Madison County deposits during 1903.

The litigation over the Ballou iron mine, which has been going on for a number of years, has finally been settled, and it is now very probable that this property will again be opened up, as it contains a large quantity of ore of good quality. It is but about 60 miles from this property to the West Virginia coal fields, and if the projected railroad from these coal fields to the coast is built it will bring these iron mines in easy communication with the coal fields, which would be the means of their being developed on a large scale and the erection of furnaces for the reduction of the ore.

The deposits of limonite iron ore at Ore Hill, Chatham County, were worked to some extent during 1903, the ore being shipped to the furnace at Greensboro.

PRODUCTION.

The blast furnace at Greensboro, Guilford County, North Carolina, operated by the Empire Steel and Iron Company, was put in operation in January, 1903, and was run less than half the time until October 19, when it was blown out indefinitely. During this period there was used 17,984 tons of ore. The shutting down of this furnace means the closing down of the mines in Johnston and Chatham counties, as these ores cannot be shipped at a profit to other furnaces.

The total production of iron ore in 1902 was 82,881 tons, valued at $78,540. This is an increase of 48,545 tons in quantity and of $25,769 in value as compared with the production of 34,336 tons, valued at $52,771, in 1902.

PYRITE.

Until 2 years ago pyrite was mined to a considerable extent in North Carolina, the principal deposit being the Oliver mine, 4 miles from Crouse, Gaston County. Since, however, this mine passed into the possession of the Virginia-Carolina Chemical Company, it has been shut down. In 1903 there was no production whatever of pyrite for use in the manufacture of sulphuric acid.

TIN.

The mineral cassiterite, tin oxide (SnO_2) containing 78.6 per cent. of metallic tin, is the only commercial source of the metal tin. This mineral is found in North Carolina in what is known as the Kings Mountain district, which extends across the southeastern corner of Cleveland County and across Gaston and Lincoln counties. From Grover, South Carolina, a station on the Southern Railway, to within a few miles of Lincolnton, Lincoln County, North Carolina, a distance of over 14 miles, tin ore has been found almost continuously, and it is reported to have been found a few miles northeast of Lincolnton; but no authentic record of this discovery can be obtained. The principal deposits that have thus far been located are in the vicinity of the town of Kings Mountain; on the southern end of Chestnut Ridge, about 2½ miles northeast of Kings Mountain; and on the John E. Jones plantation, 7 miles northeast of Kings Mountain.

The Southern Railroad passes over a considerable portion of the tin belt, following almost the general direction of the formation from Kings Mountain to Gaffney, South Carolina. At the former place the railroad turns sharply to the east, crossing the tin belt, which continues toward the northeast. Thus, any commercial deposits that may be developed will have good railroad facilities, not being more than a few miles from the railroad. Those on Chestnut Ridge are not over 2 miles from the railroad, and the ore mined could easily be hauled to the railroad at small expense. If the Jones deposit proves to contain tin in any large quantity it would still be profitable to haul the ore to the railroad at Bessemer City, a distance of about 4 miles, if it did not prove feasible to build the railroad to the deposits.

In order to obtain some idea of the percentage of cassiterite that the veins contain, a sample was taken across a 2½-foot vein at the Jones mine which gave, on crushing and panning, a concentrate of practically pure cassiterite representing from 5 to 6 per cent. of the vein. This would represent about 3½ per cent. of metallic tin. An ore carrying such a percentage of tin would, if in quantity, make a profitable proposition. Favorably located deposits have been worked that did not carry over 1½ per cent. of metal.

There was considerable prospecting done during 1903 on the North Carolina tin deposits and a ton or more of tin concentrates obtained. A full description of the Carolina tin deposits is given in the recent report published by the North Carolina Geological Survey on the Carolina Tin Deposits, which is published as Bulletin No. 19.

ABRASIVES.

The abrasive materials are among the most important of the minerals mined, and their production depends largely upon our manufacturing industries. Any decided increase in manufacturing will cause an increase in the amount of abrasive materials used, and although there may be a decrease in some particular abrasive, there will be a corresponding increase in some other. The abrasive materials are readily divided into three groups, as follows:

1. Those which occur as a rock formation and are cut and manufactured directly into the form desired while retaining their original rock structure and appearance, as grindstones, scythestones, etc.

2. Those which occur as a constituent of either a rock or a vein and have to be mechanically separated from the associated gangue and cleaned, as corundum, garnet, etc.

3. Artificial abrasives, as carborundum, crushed steel, etc.

The abrasive materials constituting these three groups are oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, pumice, infusorial earth and tripoli, crystalline quartz, garnet, corundum and emery, feldspar, carborundum, crushed steel, artificial corundum and adamite. Of the above those that are found in North Carolina are materials for making buhrstones and millstones; suitable material for grindstones and whetstones, quartz, garnet, corundum and emery. Of these, however, the only ones that have been mined for abrasive purposes during recent years are garnet, corundum and millstones.

CORUNDUM.

The corundum deposits of North Carolina were the first to be worked for this mineral in the United States, and for a number of years this State produced all of the corundum (except emery) used in the United States. Until within the last three years North Carolina had been the largest producer of corundum of any State in the country.

For the past few years, however, there has been but very little corundum mined, and during 1903 the only production of corundum was by the North Carolina Corundum Company, whose property is located at Buck Creek, Clay County. They have erected a large and complete mill for cleaning and sizing their corundum ore, which will make a very pure and efficient corundum. As this company was the only producer of corundum, their statistics are included in the total production of abrasives and are not given separately.

North Carolina
State Library.

GARNET.

A new locality for garnet for abrasive purposes was partially developed in 1903 in Madison County by Mr. M. F. Drudy. The deposit is located on Little Pine creek, near Marshall, Madison County. The garnet crystals, which are of the almandine variety, occur in a band of chloritic schist about 20 feet wide, that can be traced across country for a distance of about 1 mile. The noticeable feature of this deposit is the remarkable size of the crystals, which average at least 2 inches in diameter, some having been found 7½ inches in diameter. The crystals, though usually elongated, are well developed and dodecahedral in character. They are usually slightly altered on the exterior surfaces to chlorite, but on the interior they are sound and break with a clean, sharp, cutting edge. They are readily separated from the enclosing rock, and a pure garnet product is easily obtained. None of this garnet was mined in 1903; but mining operations were begun early in 1904, and the product already shipped has been received very favorably. On account both of the ease with which this garnet can be mined and separated and of its quality, it should readily be able to compete with any other garnet. The property is well located for railroad transportation facilities, being on the main western line of the Southern Railway, running from Salisbury, N. C., to Chattanooga, Tenn. While there was no production of garnet from this locality, sufficient work has been done to demonstrate the existence of a large quantity of the garnet and that it can be mined and cleaned and prepared for market in competition with garnet from other localities. Its abrasive efficiency is equal to the New York or Connecticut garnet.

The production of garnet in 1903 was from the Sugar Loaf mine near the summit of Sugar Loaf Mountain, Jackson County, about 1½ miles from Hall, a station on the Murphy branch of the Southern Railway. The production is not given separately, but is included under the total production of abrasives.

MILLSTONES.

For a great many years, millstones or buhrstones have been manufactured in the mountain sections of the State for local purposes. It is, however, only within the past three years that any attempt has been made to produce a millstone for commercial purposes. These stones are now being made out of the granitic rock which occurs at Faith, Rowan County, and these are manufactured by Mr. J. T. Wyatt and Mr. F. J. D. Fisher, both of Faith. The production of these stones for 1903 was 63 pairs, valued at $902, which were sold principally in North Carolina and Georgia. The demand for millstones or buhrstones has been increasing during the past few years for use in grinding the coarser cereals, mineral paint ores, fertilizers, cement rock, barytes and other minerals; and for which purposes the Rowan stone should give good satisfaction. Formerly millstones were used in very great number, principally for grinding wheat, but with the introduction of the roller-mill process there was a large falling off in the demand for the natural stone.

PRODUCTION OF ABRASIVES.

The combined production of garnet and corundum in 1903 amounted to 403 tons, valued at $12,250, as compared with 260 short tons, valued at $10,040, in 1902. This is an increase of 143 tons in quantity and of $2,210 in value. The production of 63 pairs of millstones, valued at $902, makes the total value of the production of abrasive materials in 1903 $13,152, as compared with a total value of $11,465 in 1902, an increase of $1,687. The production of these abrasive materials for 1901, 1902 and 1903 are given in the following table:

PRODUCTION OF ABRASIVE MATERIALS IN 1901, 1902, 1903.

KIND.	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
	TONS.		TONS.		TONS.	
Corundum	325	$ 48,840	----------	$ -------	403	$ 12,250
Garnet	775	43,000	260	10,040		
	PAIRS.		PAIRS.		PAIRS.	
Millstones	----------	----------	50	1,425	63	902
Total	----------	$ 91,840	----------	$ 11,465	----------	$ 13,152

MICA.

The demand for North Carolina mica is still in excess of the supply that is produced each year. On account of the comparatively low price at which mica is selling at the present time, which is especially true of the very large sheets which formerly brought very high prices, there is not the same interest in mica mining in the State as there was a decade ago. The new uses of mica for insulating purposes in electrical apparatus, which has created this large demand for mica, does not require the finest quality of mica like that obtained from North Carolina, and as the phlogopite mica from Canada and that obtained from India give just as good satisfaction and can be imported at a very cheap rate, it cuts down the price of North Carolina mica for these purposes. For stoves, lamp chimneys and for every purpose where a perfectly clear, transparent mica is required, it is the North Carolina mica that is in demand. For these purposes alone, however, there is not a sufficient market at a high enough price to support the mica mines without the production of the small electrical sheets and scrap mica as by-products. For these reasons it is often a question with the small producer whether he can make his mine a financial success or not. Where, however, the production of mica is carried on on a large scale so that a quantity of it can be kept on hand, including the large sheets for stoves, lamp chimneys, etc., the small electrical insulator sheets, disks, etc., and ground scrap mica, to supply all exigencies of the market, the mining should make a profitable investment. It is necessary, however, to mine in a very conservative manner and to utilize every scrap of the mica. There is at times an opportunity of obtaining other minerals as by-products in connection with the mica, such as quartz and feldspar, to be used for pottery purposes; beryls for gems; and uraninite or pitch-blende for its radium contents.

Where formerly a large proportion of the scrap mica produced and put on the market was obtained from old dumps and piles of scrap mica, which were thrown away during mica mining of 20 or 30 years ago, when there was no demand at all for it, at the present time a considerable proportion of the scrap mica is that obtained as waste during the present mining, and also as scrap from the cutting of sheet mica. Thus, as would naturally be expected, there has been a constant decrease in the production of scrap mica for the past few years, as many of the old dumps and piles of scrap mica have been thoroughly worked over and their scrap mica utilized. There has, however, been a constant increase in the production of sheet or plate mica during this same period.

PRODUCTION.

The total production of plate mica in North Carolina during 1903 has been estimated at 385,000 pounds, valued at $86,300, this being an increase of 55,534 pounds in quantity and of $4,647 in value as compared with the production of 1902 of 329,466 pounds, valued at $81,653. The scrap mica produced in 1903 has been estimated at approximately 300 tons, valued at $2,400, a decrease of 24 tons in quantity but an increase of $181 in value as compared with the production of 324 tons, valued at $2,219, in 1902. In the following table there is given the approximate value of the production of sheet mica by counties for the years 1900 to 1903, inclusive:

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900, 1901, 1902 AND 1903 BY COUNTIES.

COUNTY.	1900.	1901.	1902.	1903.
Ashe	$	$	$	$ 1,000
Buncombe			250	300
Haywood	11,000	11,500	20,000	18,000
Jackson	7,000	8,740	5,700	5,500
McDowell	1,000	500	600	1,000
Macon	5,200		4,000	3,500
Mitchell	26,722	33,506	28,203	29,000
Stokes	1,000		1,000	7,500
Transylvania	500	600	750	500
Yancey	12,788	25,003	21,150	20,000
Total value	$ 65,200	$ 79,849	$ 81,653	$ 86,300

QUARTZ.

PRODUCTION.

The mineral quartz is mined for a variety of purposes, such as the manufacture of glass and pottery; for abrasive purposes; as a flux and for gem purposes. In North Carolina the only direct mining for quartz is for use as a flux in copper smelting. Some quartz is found which is used for cutting into gems and ornaments. The quartz in North Carolina that has been mined for flux in copper smelting has been obtained from near Ranger, Cherokee County, which is a station on the Atlanta, Knoxville and Northern Railroad; and from the Holloway mine, Person County. The quartz from Cherokee County has been used by the smelters of the Tennessee Copper Company at Ducktown, Tenn., and that in Person County by the Norfolk smelters. The total production of quartz during 1903 was 29,462 tons, valued at $36,827, as compared with the production of 4,500 tons, valued at $11,250, in 1902. This is an increase of 24,962 tons in quantity and of $25,577 in value.

PRECIOUS STONES.

There is a great variety of gem minerals found in North Carolina at many different localities, principally in Mitchell, Macon, Yancey, Iredell, Lincoln, Alexander, Burke and McDowell counties. In Mitchell County there are found many varieties of beryl, including the aquamarine, golden and yellow beryls, blue beryl, emerald beryl and emerald matrix. The blue beryl is a very handsome gem and its color and brilliancy make it a very attractive stone. This blue color in the gem beryl is not common, and adds considerable to the value of the stone. The deep golden beryl is another very attractive stone, for which there is a considerable demand, and it is also obtained in Mitchell County in some quantity. The yellowish beryls that are found here vary from light straw through pale yellow, golden, to a deep yellow color. The emerald matrix stones continue to attract a great deal of attention, and there is a considerable demand for the emerald beryl cut in this manner, which is cut similar to the turquoise matrix gems. Some of the emerald beryl, which is not perfectly transparent, but is still of a decided emerald color, is cut *en cabochon,* and it makes very handsome green gems. A few stones are obtained that are transparent and these are put on the market with the brilliant cutting. These gems are obtained for the most part in the vicinity of Spruce Pine, and the company producing the largest amount of them is the American Gem and Pearl Company of New York. The principal gems found in Yancey County are the aquamarine beryl, some of the largest having been obtained from the

Ray mine near Burnsville. In Macon County there is a greater variety of gem minerals found, including many of the corundum gems, principally the ruby and sapphire, rhodolite, pyrope and almandine garnets; and aquamarines and golden beryls; and amethysts. The rhodolite, however, is the gem that is mined the most extensively in this county, and the American Gem Syndicate of St. Louis, Mo., is the largest producer. In Alexander County are found emerald beryls, hiddenite, quartz and rutile gems. In Iredell County the gem that is found in the largest quantity is the amethyst, and some of the finest found in the State are obtained from this county.

The demand for these semi-precious stones, as the rhodolite, beryl, etc., is constantly increasing and they are taking a place in the gem industry such as they have never done before, and the largest dealers in gem material are now putting on the market many of these semi-precious stones which formerly they would not handle at all. One reason, perhaps, for this is that these stones have a distinct color and character of their own and make up into the most attractive jewelry; and as they are brilliant and beautiful they are becoming to be appreciated for their real value, especially as the public is beginning to recognize them as distinct gems and not as imitations of others.

PRODUCTION.

There was but very little systematic mining for gems during 1903 and most of this work was confined to Mitchell County. The total value of the gems produced was $1,525, which is a decrease of $3,775 as compared with the value ($5,300) of the production in 1902. There was but a very small production of the rhodolites, which is not due to the lack of demand for these stones, or. as far as can be learned, to the exhaustion of the deposits.

RARE MINERALS.

With the discovery of radium there has been considerable interest centered in the pegmatitic dikes of Mitchell County, which contain the uranium mineral, uraninite, or, as it is commonly known, pitchblende, the mineral from which all of the radium has been obtained. The mine that has produced the largest amount of this mineral is the Flat Rock mine near Spruce Pine, with smaller amounts from the

Buchanan, Wiseman and Deake mines. A small amount has also been found at the Ray mine, Yancey County. In comparing the pitch-blende found at Flat Rock mine with that from other localities, especially that from Bohemia, it was found that this Flat Rock pitch-blende showed a greater radio-activity than any of the others. This determination was made by Dr. B. B. Boltwood* of New Haven, Conn. At the Flat Rock mine there seem to be certain portions of the vein which contain the pitch-blende in some quantity, while in other portions a considerable distance may be traversed without encountering any of this mineral. As it is not evenly distributed in the pegmatitic dike, it is impossible to determine what percentage of this mineral could be obtained from systematic working of this mine. This mine has not been in operation for a number of years; but during the early working of the mine pitch-blende was thrown away. With the discovery of radium and the consequent demand for pitch-blende, the old dumps of this mine have been pretty thoroughly worked over by the people in the vicinity in search of this mineral, with the result that a good many pounds have been sold during the past year, the price rising from $1 to $9 per pound during the year. There are a number of other uranium minerals found in these pegmatitic dikes, some of which, such as the gummite, are surrounding the pitch-blende as an outer covering and have resulted from its direct alteration.

Samarskite, which is a mineral containing many of the rare earth metals, and also a small percentage of uranium, has been found in considerable quantity in Mitchell County, principally at the Wiseman mine. The demand for this mineral is not large, but during the past year the small amount that was obtained was sold readily at from 50 cents to $1 per pound, according to the purity of the mineral.

PRODUCTION.

The total production of these rare minerals during 1903 was valued at $270, the greater part of which was the value of the uraninite (pitch-blende).

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*At the laboratory of Pratt & Boltwood, 139 Orange Street, New Haven, Conn.

MONAZITE AND ZIRCON.

INTRODUCTION.

On account of monazite and zircon being mined for similar purposes—*i. e.*, for the rare earth oxides that they contain—they are treated together in this report. The oxides obtained from these minerals are used in the manufacture of mantles for various incandescent lamps and for the glowers of electric lamps. The demand for monazite is increasing and considerable of that mined in the State is now being exported to Germany. All of the zircon mined, however, is consumed in the United States in the manufacture of the glowers for the Nernst electric lamp.

MONAZITE.*

Monazite, which is essentially an anhydrous phosphate of the rare earth metals, cerium, lanthanum and didymium, usually contains a varying but small percentage of thoria. It is the presence of this latter oxide that gives the monazite its commercial value. There is a very wide variation in the percentage of thoria that the monazite contains, but the commercial monazite that is put on the market contains from 3 to 9 per cent. of this oxide. The thoria, together with very small amounts of lanthanum and didymium oxides, are used in the manufacture of the cylindrical hood or mantle of the Welsbach and other incandescent gas lights. The cerium oxalate obtained in the separation of the other oxides, is used to a limited extent in pharmacy.

Monazite varies considerably in color, being light yellow to honey yellow, reddish, brownish and yellowish green, and has a resinous to vitreous luster. It is brittle, breaking with a conchoidal or uneven fracture, and is from 5 to 5.5 in hardness. The mineral is heavy, having a specific gravity of 4.64 to 5.3. By means of its color and specific gravity it can usually be readily identified.

Localities.†

Commercial deposits of monazite are not found in the original rocks, but in the gravel deposits of the present and former streams, which have resulted from the disintegration and erosion of the crystalline rocks which contain the monazite. These rocks have been altered and decomposed to a considerable depth, so that at the present time they are in a state of constant erosion; and their mineral constituents, monazite, zircon, magnetite, etc., are being deposited in the soils and gravels. This is going on to such an extent that even after the soils and gravels have been once worked for monazite, they may be rewashed at the end of the year and prove profitable sources of monazite.

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*United States Geological Survey: Mineral Resources of the United States, 1903.

†In the field work assistance has been rendered by Mr. Douglass B. Sterrett of Yale University.

The supply of monazite is obtained from Cherokee and Spartanburg counties, South Carolina, and from Rutherford, McDowell, Burke, Cleveland and Lincoln counties, North Carolina. There are large numbers of small miners in most of these counties who produce from a few pounds to a ton of monazite per year. Many of these do not concentrate their product beyond that effected by sluice-boxes, and they sell their material to some one of the four companies who are buying monazite, either for their own use or for exportation. These concentrates vary considerably in color, according to the locality from which they have been obtained, and there are consequently monazite concentrates of a red, red-brown, brown, yellowish brown, yellowish green and yellow color.

Rutherford County.—One of the main centers of the monazite mining industry in the State is Ellenboro, Rutherford County. Near this place is located the property of the German Monazite Company. This company is working 26 or more men, who wash out about 1½ tons of cleaned sand each week. Their workable gravel is from 20 to 100 yards wide and extends for half a mile up and down the creek. The overburden, which has to be removed, is from 1 to 5 feet in depth, some of which carries a small amount of monazite.

Three miles from Ellenboro, at the Louisa Smart mine, three different colored monazite sands are found, which are not more than 100 yards apart, one being of a greenish color, another brownish red, and the third yellowish. The first is found along the small branch just above the drying plant, the second is found higher up on the hill-side, about 60 feet from the stream. These two gravels are being sluiced on but a small scale at the present time. These gravels pan well and were quite free from garnet, and contained but a little of the black sand. The gravels are 3 feet thick, and are covered by 2 to 3 feet of an overburden of red clay. The third, or yellowish monazite sands, are now being washed; but they contain some garnet and heavy iron minerals. The brownish sand readily concentrates to a product containing 80 per cent. monazite. This property would be more extensively worked but for the lack of a sufficient water supply. Near these gravel deposits, a pegmatitic dike 4 feet in width was observed cutting the hornblende gneiss. This dike contained a great many garnets up to the size of a walnut and also monazite, which was proved by panning the crushed rock.

There are several places near Ellenboro where monazite is being mined. One is on the property of Mr. E. A. Martin, where a good percentage of monazite is obtained in panning the stream gravels and also the gravel for some distance under the banks; but the total area of the pay gravel is not large. Another is on the west fork of Sandy Run creek, on the land of Mr. J. C. Glover, where there is a considerable quantity of gravel, but it did not show a very large percentage of monazite on panning. The gravels are from 2 to 3 feet in thickness under an overburden of from 1 to 2 feet. There is, however, a good water supply which is favorable for working the gravels in quantity. Only two sluice-boxes were worked during the past year on this property. Again, on a small tributary of Sandy Run creek, on the land of Mr. J. D. Bridges, the stream-gravel and the gravel and soil on the banks are exceedingly rich in monazite, but the area of the gravels is not very extensive.

Three miles southeast of Ellenboro, on a small branch running through the plantation of Mr. D. B. Farrill, the gravels have been pretty well worked out once and are now being worked over the second time, yielding fairly good results. Only one sluice-box, however, was being worked during 1903, although there was a sufficient water supply for using several.

At Rutherfordton is another center of monazite mining and on the land of Mr. A. D. K. Wallace, 2 miles from Rutherfordton, considerable work has been carried on. The gravels in the bottom-land are often 100 feet across and from 1 to 3 feet thick. The overburden, which is not very heavy, contains some monazite and is washed similarly as the gravels. There are two branches on this property containing workable gravel deposits, varying from 50 to 150 feet in width and about a quarter of a mile in extent. There is a good water supply on this property. About half a mile west of the Wallace deposits, on the land of Mr. H. Harris, the gravels that extend up and down the stream for a distance of nearly a mile have been washed. At Peppertown creek, where some mining has been done for monazite, the concentrates are low in monazite, being made up largely of black magnetic sand.

At Duncan, 17 miles from Ellenboro, on the land controlled by Mr. Henry Gettys, there are 30 acres of bottom-land, extending about a mile along the stream, which contain considerable monazite. The stream-gravels are to be washed first and then the bottom-land. Six or eight troughs will probably be used. In the same vicinity, on the land of Mr. S. A. Mode, the stream-gravels and bottom-gravels contain considerable monazite and there is a good supply of water.

Cleveland County.—On the land of Mr. A. M. Hunt, 6 miles from Casar, Cleveland County, there were two sluice-boxes operated in 1903, although the gravel deposits would warrant more, and there was an abundant water supply with which to develop them. The gravels panned very well, showing a good percentage of monazite. They varied in thickness from 2 to 3 feet, and there was good width of bottom-land that had only been partially worked out. Near the upper end of this land the stream-gravels are profitable to work over a number of times, as there has been no work done on the adjoining property and the rains are constantly bringing down new sources of supply of monazite.

In the vicinity of Carpenter's Knob, Cleveland County, there are some very promising gravel deposits containing monazite, a number of which are being worked by the Incandescent Light and Chemical Company of New York City. On the land of Mr. J. C. Crow, the bottom-land gravels are from 30 to 75 yards wide and will average about 2 feet in thickness. During 1903 there were 2 sluice-boxes at work on these gravels and 2 on the land of Mrs. Eliza Spakes further up the stream. These lands are on the head-waters of Little Knob creek. Further down on the creek, on the McSneed property, the monazite gravel was observed in one place to be 7 feet thick. Two sluice-boxes were in operation on this property, but there is a sufficient supply of water to work more, which would be warranted by the quantity of gravel. Little Knob creek has been worked more or less from near its source to its mouth, but in many places the gravels have received new supplies of monazite, so that it will pay to wash them again. On the property owned by the Incandescent Light and Chemical Company, five sluice-boxes were operated in 1903 and the stream-gravel will be worked for about a mile. In a number of instances, bottom-gravels that had formerly been washed are now being washed again and at a profit. The gravel in some places is 5 feet in thickness. This company also own and are working monazite gravels on Camp creek in Burke County, and the Lattimore mine near Shelby, Cleveland County. They expect to erect a concentrating or cleaning mill near Carpenter's Knob. Another good deposit of stream-gravel and bottom-land gravel is on the land of Mr. W. E. Ledford, near Carpenter's Knob. These gravels pan very well and there is a good water supply.

On Knob creek there are very extensive stream-gravels and considerable bottom-land gravels which, while they do not contain a very large percentage of monazite, are extensive in area, and as there is a good water supply they could be worked on a large scale and therefore could be mined profitably.

Near Mooresboro, Cleveland County, there are a number of small producers of monazite. The most work is done on the land of Mr. H. C. Burrus, who operated three sluice-boxes or troughs in 1903. There is a considerable area of bottom-lands, but only small portions of these are being washed for the monazite. The branch flowing through this property has been worked for a distance of about a mile and contains workable deposits of 100 yards in width. The concentrates, however, contain a rather large percentage of the black sand.

Burke County.—In Burke County, on Brindletown creek and its tributaries, are many properties containing good deposits of monazite gravels, such as those of Captain J. E. Mills, Mr. John Kirksey and Mr. Moore Epley.

McDowell County.—In McDowell County, there are numerous good deposits of monazite on the waters of Muddy creek, but an act of the Legislature prohibts the use of these streams for sluicing pur-

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poses, and thus prevents the mining of monazite on the adjacent properties.

There is a tendency among a large number of the farmers who own lands containing monazite gravels to work only the stream-gravels, which they do two or three times a year, leaving the bottom-land untouched except for farming. The heavy rains wash the sands in from the hill-sides, from under the banks and from the streams above, thus renewing the monazite in the stream-gravel. These surface soils seem to contain a considerable per cent. of monazite for 6 or 8 inches of their depth, which has resulted from the decomposition and disintegration of the adjacent rocks. The sands that are obtained from the sluice-boxes are sometimes re-washed by the miners, but usually it is sold directly to some one of the companies owning the concentrating plants.

Methods of Drying Monazite Concentrates.

The weighed concentrates are dried in two different ways. One way consists of spreading the sand over an oiled or rubber cloth in the sun, where it dries very quickly, due partly to the heat absorbed by the dark iron sand. The other method of drying is by heating over a furnace. A small ditch from 4 to 8 feet long and 1 to 1½ feet wide and about 1 foot deep is dug, at one end of which there is built a rock or brick chimney. Over the ditch there is a sheet-iron cover. The monazite is spread out on this sheet-iron drying-plate, under which there is a hot fire.

Concentrating Mills.

The concentrating mills that are now being operated in the monazite district are those of the Carolinas Monazite Company, located at Shelby, Cleveland County, North Carolina, and Gaffney, Cherokee County, South Carolina; that of the German Monazite Company at Oak Springs, Rutherford County; and that of the Incandescent Light and Chemical Company near Carpenter's Knob, Cleveland County.

Further cleaning of the concentrates that are obtained from the sluice-boxes by the miners has been perfected to such an extent that now a cleaned monazite sand can be obtained that is from 95 to 99 per cent. monazite. This has been effected by means of the Wetherill Electro-magnetic Separator. The dried concentrates are placed in a hopper and from there fed to a classifier. The finer material, which contains the monazite, is allowed to pour over a revolving drum, and is thus scattered evenly over an 18-inch belt. This passes along under four powerful electro-magnets, which have small belts to carry the material attracted by the magnets out of the magnetic field. As soon as such a point is reached, the belt drops the sand, which passes through a chute to the proper receptacle, placed to receive it. The first magnet removes all the magnetic iron, the larger pieces of garnet and generally all of the titantic iron or ilmenite. If any of the latter passes this belt it is removed with all of the finer garnet sand by the second magnet. The third magnet is so adjusted as to remove only the coarse monazite, and the fourth removes all of the finer pieces of monazite. The remaining sand, quartz, zircon, rutile, etc., is dropped off the end of the large belt and is run into the waste pile.

The garnet, which is of very good quality, having a hardness of 7.5, will, if it is obtained in some quantity, be of value for abrasive purposes. There is some gold contained in these tailings, but no attempt is made to save it.

In washing some of the monazite gravels, the gold which they contain is saved and in many instances has amounted to $1 or more per sluice-box per day.

ZIRCON.

The mineral zircon is a silicate of zirconium ($ZrSiO_4$) and is commonly found in square tetragonal prisms terminated by the pyramid. It is usually of a grayish, light brown to a reddish brown color. Occasionally it is found colorless to red and perfectly transparent, when it becomes of value as gem material. In hardness it is 7.5 and has a specific gravity of 4.65. Besides the use that is made of the transparent varieties of this mineral for gems, there is a certain amount that is mined for its zirconia content. This oxide is used together with yttria in the manufacture of the glower for the Nernst electric lamp.

Occurrence and Localities.

Zircon is commonly found sparingly in the crystalline rocks, especially gneisses, syenites, granites, in granular limestones, and in chloritic and other schists. Occasionally it is found associated with some of the iron ores. Occurrences of this mineral in quantity are not common, and there is but one locality in the United States where it has thus far been found in commercial quantity and that is in the vicinity of Zirconia, Henderson County, North Carolina. The zircons occur in a pegmatitic dike which is about 100 feet wide and has a strike of N. 50° E. It cuts up through the old Archean gneisses, and can be traced for a distance of about 1½ miles. The upper portions of the pegmatitic dikes are badly decomposed and kaolinized to a depth of 40 feet or more. The zircons occurring in these dikes are of a grayish color and well crystallized, prismatic crystals terminated by the unit pyramid predominating. They occur for the most part in the feldspar, and where this is kaolinized it permits of an easy separation of the zircon crystals by hydraulic processes. As the feldspar becomes more solid and unaltered, the separation of the zircon is more difficult. In crushing the feldspar, however, the zircons readily free themselves from the gangue. There are two deposits of these zircon crystals that have been worked; one near the southwestern end of the pike, which is known as the Freeman mine, and the other near the northeast end, which is known as the Jones mine. Owing to the slight demand for this mineral, there is no systematic mining carried on. Men and children are paid a certain price per pound for the zircon crystals, some of which they wash out of the soil, others out of the kaolinized gangue, and still others they break out by hand from the harder feldspar. The resultant product contains practically 100 per cent. of zircon.

Near New Sterling, Iredell County, a great many brownish, pyramidal crystals of zircon have been found in the soil, some of which were 1 to 3 inches in diameter. One crystal weighed about 6 ounces. The exact occurrence of these crystals has not as yet been definitely determined, but thus far there has been observed no indication of a commercial quantity.

There are small quantities of zircon found in all the monazite sands, which could probably be saved as a by-product. These crystals are very minute, and are transparent.

PRODUCTION.

The total production of monazite in North Carolina during 1903 was 773,000 pounds, valued at $58,694, which is a decrease of 29,000 pounds in quantity and of $5,466 in value as compared with the production of 802,000 pounds, valued at $64,160, in 1902. The above amount represents the purified sand containing from 85 to 99 per cent. monazite. This was obtained from about 1,600,000 pounds of crude sand as taken from the sluice-boxes, which is the material that goes through the magnetic separators. The price received for this crude sand by the individual miner varied from 2½ to 6 cents per pound, according to the percentage of thoria that it contained. Cleveland County leads in the quantity and value of its production.

The quantity of zircon obtained in 1903 was 3,000 pounds, valued at $570. This makes the total production of these minerals mined for use in the manufacture of various lamps amount to 865,000 pounds in quantity, valued at $65,200. In the table below there is given the production and value of monazite mined in North Carolina from 1893 to 1903:

PRODUCTION OF MONAZITE IN NORTH CAROLINA FROM 1893 TO 1903.

YEAR.	POUNDS.	VALUE.
1893	130, 000	$ 7, 600
1894	546, 855	36, 193
1895	1, 573, 000	137, 150
1896	30, 000	1, 500
1897	44, 000	1, 980
1898	250, 776	13, 542
1899	350, 000	20, 000
1900	908, 000	48, 805
1901	748, 736	59, 262
1902	802, 000	64, 160
1903	773, 000	58, 694

BARYTES.

The principal use that is made of barytes is as a white pigment, and the first grade of this mineral, after being ground and made ready for use, is known as "floated barytes." Whereas, formerly this mineral was considered as an adulterant, it is now recognized that barytes has excellent qualities of its own that make it of value as a pigment. Hence, at the present time, barytes is put on the market as a pigment and in competition with white lead and other white pigments. It has a pure white color, which is permanent, and it is unaffected by the weather or by gases that in some cases blacken white lead. It can also be used to advantage in combination with other white pigments, as white lead or zinc white. Of the total production of barytes, about four-fifths is used in the manufacture of white pigments. Other uses are in the manufacture of paper and rubber and also in the preparation of material that is used to coat canvas sacks in which hams are wrapped and made ready for market. Another use for this mineral that is increasing is in the manufacture of other barium compounds, principally the hydroxide.

Barium hydroxide was formerly prepared almost exclusively from the mineral witherite, barium carbonate; but on account of its rare occurrence in commercial quantity manufacturing chemists have been obliged to take up barytes as the raw material for manufacturing the hydroxide and other salts of barium. The principal use of barium hydroxide is in the beet sugar industry for the separation of the sugar left in the molasses. It is applicable in the same manner in the cane sugar industry. Another application that can probably be made of barium hydroxide which would cause it to be used in considerable quantity, is as a purifier of water used in some boilers. This would be especially applicable to acid waters. Still another use that has been considered is in the preparation of hides for tanning. As a pigment there are many ways in which barium white can be used, either as a preparation of the sulphate or as double salts.

PRODUCTION.

The production of crude barytes in North Carolina during 1903 was obtained principally from Madison County, with a small quantity from Gaston County, and amounted to 6,835 tons, valued at $21,347. This is a decrease of 7,844 tons in quantity and of $22,783 in value, as compared with the production of 1902, which was 14,679 tons, valued at $44,130. The average value per ton of the 1903 production was \$3.12½. In the following table there is given the production of barytes in North Carolina for the years 1901, 1902 and 1903:

PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA DURING 1901, 1902 AND 1903.

YEAR.	QUANTITY, SHORT TON.	VALUE.
1901	6, 890	\$ 20, 865
1902	14, 679	44, 130
1903	6, 835	21, 347

The quality of the North Carolina barytes is of the best, and as the demand for barytes is constantly increasing it was expected that the production of 1903 would have been at least equal to that of 1902. One thing that is against these deposits is their distance from the market, the crude barytes being shipped either to Lynchburg, Va., or Bristol, Tenn., or St. Louis, Mo. Thus the Virginia, Tennessee and Missouri deposits have an advantage in freight over those of North Carolina.

TALC AND PYROPHYLLITE.

PRODUCTION.

The demand for North Carolina talc, such as is found at the Hewitt mine in Swain County, is at the present time considerably greater than the supply. This particular deposit is unique in its occurrence and furnishes a talc which is much sought after for the manufacture of tailors' pencils, etc. The counties producing talc in 1903 were Swain, Cherokee, Madison and Jackson, given in the order of the importance of their production, while the pyrophyllite was obtained from Moore County. There is a small amount of the soapstone variety of talc quarried each year in the mountain counties, Alleghany, Yancey and Mitchell, which is used for fire-places, etc. The total production of these minerals in 1903 amounted to 5,331 tons, valued at \$76,984, which shows an increase of 92 tons in quantity, but a decrease of \$11,978 in value as compared with the production for 1902 of 5,239 tons, valued at \$88,962. The decrease in the value, with a slight increase in quantity, is due to the smaller quantity of the higher-priced talc mined at the Hewitt mine. The largest amount of this production was obtained from Swain County, with smaller productions from Cherokee and Moore counties. The condition in which this production was marketed is shown in the following table:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1901, 1902 AND 1903.

CONDITION IN WHICH MARKETED.	1901.		1902.		1903.	
	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.
Ground talc for powders, etc.	2,864	$ 29,505	3,381	$ 31,628	3,762	$ 37,606
Talc cut into pencils, gas tips, etc.	375	26,000	371	42,017	265	27,615
Talc sold crude	2,580	22,319	1,487	15,317	1,304	11,763
Soapstone cut into slabs for chimneys, etc.		150				
Total	5,819	$ 77,974	5,239	$ 88,962	5,331	$ 76,984

In the table below there is given the value and quantity of talc and soapstone produced in North Carolina from 1898 to 1903, inclusive:

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1903, INCLUSIVE.

YEAR.	QUANTITY.	VALUE.	YEAR.	QUANTITY.	VALUE.
	SHORT TONS.			SHORT TONS.	
1898	1,695	$ 27,320	1901	5,819	$ 77,974
1899	1,817	31,880	1902	5,239	88,962
1900	4,522	75,308	1903	5,331	76,984

GRAPHITE.

Although there is only a very small amount of graphite mined in North Carolina, yet on account of the numerous occurrences of this mineral throughout the State and of its high commercial value and demand, the subject is treated much more in detail than the actual production of the mineral warrants. It is not improbable but that some of the localities where graphite is known to occur may develop into properties of commercial value, and this is especially true of some of those which at the present time are at some distance from railroad transportation, but which may, in the next few years, become available by reason of the railroads having penetrated into these districts.

Graphite is a mineral almost universally used, and there are but few households that are without it in one form or another. It is a mineral that was formerly but little understood, and even at the present time there is a vagueness regarding its value and uses and, in fact, regarding the character of the mineral itself. This is partially due to the different names that have been given to it in various localities in accordance with its uses, these names being graphite, black lead and plumbago. The mineral commonly occurs in embedded, foliated masses and also in granular, compact and micaceous masses, sometimes of a slaty structure and at other times earthy. Occasionally it is found in six-sided tabular crystals, but the faces of these are seldom distinct. In the foliated variety it has a perfect basal cleavage, the thin laminæ when separated being flexible but not elastic. In color it varies from black to a dark steel-gray, and it has a metallic to sometimes dull and earthy luster and a greasy feel. In hardness it will vary from 1 to 2 and in specific gravity from 2.1 to 2.23, due to the amount of impurities. It closely resembles in physical properties the mineral molybdenite, a sulphide of molybdenum (MoS_2), which, however, gives a bluish-gray streak on paper, while the graphite gives gray-black. Chemically, however, the graphite is readily distinguished from the molybdenite, as its composition is carbon, although often impure from the presence of iron sesquioxide, clay, quartz, etc. The properties of graphite that make it especially valuable for the purposes for which it is used in the mechanic arts are softness, flexibility, low co-efficient of friction, conductivity, large adhesiveness, and exceedingly slow oxidation at high temperatures.

OCCURRENCES AND VARIETIES.

Graphite as a mineral is widely distributed in nature and occurs in gneisses, mica schists, crystalline limestones and pegmatitic dikes.

As an ore deposit, however, it is found in but few places, occurring in beds and embedded masses and laminæ or scales in the rocks just mentioned. Schists are often impregnated with graphite to such an extent that they become graphitic schists, and have been observed extending over a number of miles of territory. Occasionally it is found in meteoric irons from a fraction up to 3 per cent. The world's supply of graphite is obtained from the following countries: Austria-Hungary, Ceylon, Germany, United States, Canada, Italy, Japan and Mexico, with, however, the larger amounts obtained from Austria-Hungary and Ceylon, these two countries together producing nearly six times as much as all the other countries combined.

There are three distinct varieties of graphite on the market—crystalline, amorphous, and artificial. These are used to some extent for the same purpose, but there are some uses to which each is especially applied. Of the two natural forms of graphite the crystalline is the more valuable, and is usually a purer grade of graphite, being worth about $70 per ton, while the amorphous is only worth about $15 per ton. The artificial graphite averages still higher in value, about $92 per ton, this being due to the particular form in which some of it is produced.

Crystalline Graphite.—This variety can be used for all purposes for which graphite is required, but its chief uses are in the manufacture of refractory products, lubricants, electrotypes, and pencils, for which it is especially adapted on account of its purity. It has been estimated that of all the crystalline graphite consumed in the country, 55 per cent. was for crucibles, 15 per cent. for stove polish, 10 per cent. for foundry facings, 5 per cent. for paint, and 15 per cent. for all other purposes, including pencils, powder glazing, electrotyping, steam packing, and various other minor uses.* The coarser and purer form of the crystalline graphite is used for the manufacture of crucibles, pencils, lubricants, and electrotypes, and is known on the market as lump graphite and chip graphite, the former being more valuable. For the other purposes, as in the manufacture of stove polish, foundry facings, paints, etc., those grades of crystalline graphite known as dust and sweepings are used, the dust having the higher price.

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*Mineral Resources U. S. for 1902; U. S. Geol. Survey, 1904, p. 975.

The bulk of the world's supply of crystalline graphite is obtained from the island of Ceylon. The refining of crystalline graphite is accomplished with but little difficulty, and the resultant product is usually very pure and free from any injurious compound. In some instances masses of the crystalline graphite are obtained that need no refining, and are ready for the crusher after simply being hand-cobbed.

Amorphous Graphite.—The occurrences of amorphous graphite are very much more abundant than those of the crystalline variety, but on account of the difficulty experienced in refining the crude ore, many of these deposits are not at the present time of commercial value. There are still others that are so isolated from railroad transportation facilities that it is impracticable to attempt to work them. Schists are often impregnated with graphite to such an extent that they become graphitic schists, and they have been observed extending over a number of miles of territory. Usually these schists contain also minute particles of quartz (silica), and although they may carry a very high percentage of graphite, it is impossible in many cases to obtain commercially pure and marketable graphite. This is due partly to the intricate manner in which the grains of quartz and graphite are intermingled, which makes it almost impossible to separate the quartz completely from the graphite, even by extremely fine crushing. Then again graphite and mica are found lying in parallel positions, so that it is almost impossible to separate the foliæ of one mineral from those of the other. In some instances the deposits of graphite are worked on a limited scale, and the production is shipped directly as mined for use for foundry facings and paints.

Such deposits of graphite occur very extensively in McDowell County, where there is a series of strata of graphitic schists in a country rock of mica schist and gneiss. These strata vary widely in percentage of graphite, some being quite lean and others richer. These graphitic schists can be traced for a distance of about 3 to 4 miles in a N. E.-S. W. direction from Brush Mountain on the west to Fork Mountain on the east. The deposit first becomes prominent near the Mill creek trestle of the Southern Railway. In width it is about 275 feet, with a very lean streak of the graphitic schist near the center. The deposit occurs up and down five ridges, each of which rises to a height of 500 feet or more above the general level of this section of the country. Before attempting to work such deposits of graphite, they should be thoroughly tested as to whether or not they can be cleaned commercially. Deposits which may be very similar to each other, as far as one can judge from looking at them in the field or in the hand specimen, will differ very materially in respect to how they lend themselves to a cleaning process.

Another deposit similar to the above occurs three miles north of Raleigh, Wake County, and at these deposits graphite has been mined to some extent for the past four or five years.

The occurrence of graphite in pegmatitic dikes is well illustrated by the deposits in Alexander County about five miles from Taylorsville. The country rocks are schists and gneisses, and cutting through these are the pegmatitic dikes, varying from a few inches to 5 feet or more in thickness. The graphite, as it occurs in these pegmatitic dikes, is in the form of small particles and nodules from a fraction of an inch to 6 or more inches in diameter. As these pegmatitic dikes are more or less decomposed, the graphite in the upper portions of the dikes is more or less stained with iron oxide; but as the work on the deposit is continued deeper but little of the graphite was stained. The nodules of this mineral, when broken open, were found to be nearly pure, and on testing them no grit was observed. Nodules of the graphite occur quite abundantly on the eastern and northeastern slopes of Barrett's Mountain and for a distance of over 2 miles in a direction of a few degrees west of south. Only in a few places, however, in this belt has the graphite been located in place. What is apparently a similar occurrence of graphite has been found near Henrietta, Rutherford County, on the farm of Mr. Robert R. Simmons. The graphite has been found on the surface for over half a mile along the slopes of the ridge, and a number of pits have been sunk in an attempt to locate the graphite in place. The National Graphite Company continued the development of their graphite property in Yancey County about 7 miles east of Burnsville and will undoubtedly be shipping graphite late in the year of 1904.

There are large quantities of the amorphous graphite used in the manufacture of paints and for foundry facings. Some is also used in the manufacture of crucibles. The difficulty of purification of the amorphous graphite prevents its use for the manufacture of lubricants, the better quality of pencils, electrotypes, etc., except in a few instances, as in the case of some of that obtained from Bavaria and Mexico, and from one or two places in the United States.

Artificial Graphite.—Methods for the production of artificial graphite have been known for a great many years, but it is only within the last eight years that a method has been devised for manufacturing it commercially. The three principal methods by which artificial graphite has been made are: (1) By heating amorphous carbon to a very high temperature in the electric furnace. (2) By dissolving an excess of carbon in a molten metal at a high temperature; on allowing the metal to cool down the excess of carbon separates out as graphite. (3) By the dissociation of certain carbon compounds by means of metallic iron, or iron oxide, at high temperatures.

EXAMINATION OF GRAPHITE DEPOSITS.

On account of the constant increase in the demand for graphite, and of the fact that there is from six to ten times as much graphite imported into the United States as there is mined in this country, there is a great deal of interest aroused over the discovery of any large deposit of this mineral, especially of the crystalline variety. Any deposit of this mineral within reasonable distance of railroad transportation is worthy of investigation. There are, however, a number of points to be taken into consideration in estimating the value of a graphite deposit beside its location and cost of mining, which are: (1) Its variety, crystalline or amorphous. (2) The percentage of graphite in the ore. (3) The impurities that contaminate the ore, as mica, quartz, iron oxide, clay, etc. (4) Whether these impurities can be eliminated commercially. (5) The purpose for which the cleaned graphite can be used. Although it is important to know accurately the percentage of graphite that an ore carries, this is not of the first importance. It is very essential to determine whether or not the graphite ore can be so cleaned and refined as to produce a marketable product, and this should be deter-

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mined before any large amount has been spent in the development of the deposit.

METHODS OF CLEANING.

The difficulties in purifying graphite have prevented the working of many deposits, even though they contain a considerable percentage of this mineral. The general methods employed for separating graphite from its impurities are based on the differences of specific gravity between it and its associated minerals. In these processes consideration is given to the difference in form between the particles of graphite and those of the gangue minerals. One of the minerals that is often difficult to separate from the graphite is mica, on account of its occurring in similar foliæ to that of the graphite, thus offering nearly the same surfaces to the solutions or blasts of air as the graphite. Briefly, the two principal methods used for purifying graphite have been described by Mr. W. F. Downs, E. M.,* as follows:

> *Treatment for purification by air.*—This has long been a favorite field for experiment. The thin, flat scale of graphite offers more resistance to a current of air than an irregular fragment of gangue. The usual form of air jigs is further supplemented by settling chambers, dust-collectors, etc. These machines concentrate, but it is doubtful if they will make any pure graphite. Though frequently tried, they have never come into general use.
>
> *Treatment by water.*—The amorphous grades are levigated on a large scale in Europe. This method frees the ore of coarse particles, but the earthy impurities carry over to the last settling vessel and much remains with the graphite. Even when the washing is carried to the extent that filter presses are used, clayey impurities still follow the graphite. The crystalline varieties occurring in the gneiss and schistose rocks are the most susceptible of treatment. These are crushed to a fineness sufficient to dissociate the graphite from the gangue, and first separated in buddles. This separation is of course incomplete, but when supplemented by sizing, regrinding, floating, etc., is carried to quite a high degree. These methods have attained great perfection in the United States.

For most of the purposes for which graphite is used it is not necessary to have it pure; but in the manufacture of electric goods, lubricants, and pencils, this is absolutely necessary. It is, however, the other uses that consume by far the most of the graphite that is mined.

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*The Iron Age, May 3, 1900.

PRODUCTION.

The production of graphite during 1903 amounted to 50 tons, valued at $248, as compared with a production of 830 tons, valued at $4,300, in 1902. This is a decrease of 780 tons in quantity and of $4,052 in value, and is due to the shutting down of the deposits at Graphiteville in McDowell County, which produced graphite in some quantity during 1902. The amount of graphite produced in the United States during 1903 was 18,860 tons, valued at $225,554, of which only about 4,000 tons were used for the ordinary purposes of graphite. The balance of the production of 1903, which was sold at a price of about $2 per ton, was used in the manufacture of fertilizers. Besides this natural production of graphite, there were 1,310 tons, valued at $178,670, of artificial graphite produced. There was also imported into the United States 17,628 tons, valued at $1,207,730. This makes a total of 22,758 tons, valued at $1,568,589, after deducting the amount of graphite that was mined for fertilizer purposes. As is seen from the above, the amount of graphite imported for the manufacture of paints, lubricants, crucibles, slate pencils, etc., is about four times the amount produced in the United States, and thus emphasizes the benefit that would be derived by the United States if large deposits of commercial graphite could be found.

COAL.

PRODUCTION.

There are no extensive coal fields in North Carolina, and the only deposits that have thus far been worked on a commercial scale are those in Chatham County known as the Cumnock mines. This coal contains more or less sulphur, and it is very probable that its value could be very materially increased by washing. At the present time this coal is valued at about $1.46 per ton f. o. b. mines, the price per ton having increased from $1.07 in 1901 and $1.24 in 1902. Similar coal measures occur in Stokes County near Walnut Cove, but no development work was done on these deposits during 1903, although it is expected that during the coming year they will be thoroughly prospected. The production of coal during 1903 in North Carolina amounted to 17,309 tons, valued at $25,300, as compared with the production of 23,000 tons, valued at $24,500, in 1902. This is a decrease of 5,691 tons in quantity but an increase of $800 in value. The increase in value per ton of the 1903 production over that of 1902 was 22 cents.

STONE.

There is a great variety of stone suitable for building purposes occurring in North Carolina, but at the present time only a few of the deposits have been thoroughly developed. The stones that are being utilized are granite, sandstone, marble and limestone; while the deposits of slate and serpentine which occur in quantity and of good quality have not as yet been developed to any great extent. There was a consolidation of a number of quarries during 1903, which included the large granite quarries of Thomas L. Woodroffe & Sons at Mt. Airy, Surry County. The name of the new corporation is the North Carolina Granite Corporation, whose home office is at Philadelphia, Pa.

Although the condition of the stone industry in the State at the close of 1903 was much better than at the close of 1902, yet the actual value of the production during 1903 was somewhat smaller than that of the previous year. In 1903 the value of the total production of building stones was $360,322, as compared with $366,727, the value of the production in 1902, this being a decrease of $6,405.

In the following table there is given the value of the productions of the different stones quarried in 1902 and 1903:

PRODUCTION OF BUILDING STONE DURING 1902 AND 1903.

STONE.	1902.	1903.
	VALUE.	VALUE.
Granite	$ 338,749	$ 334,357
Sandstone	4,825	600
Marble and Limestone	23,153	25,365
Total	$ 366,727	$ 360,322

During the year 1903 investigations were carried on in the field relating to the occurrences of building stones in North Carolina, and the results of this work will appear shortly as Volume 3 of the

North Carolina Geological Survey. This report takes up in detail a description of the occurrences of the various building stones, their economic value and chemical and mineralogical composition.

GRANITE.

Production.

The total value of all the granite produced in 1903 was $334,357, which is a decrease of $4,492, as compared with the value of the production for 1901 of $338,749. This production does not begin to represent what the granite industry of the State should attain when the quality as well as the quantity of the various varieties of granite are considered. Many of the quarries are very well located for railroad transportation and the occurrences of the stone are such that they can be quarried the most economically. The number of operators engaged in quarrying granite during 1903 was 24, who worked at 26 different localities in the following 12 counties: Surry, Rowan, Buncombe, Catawba, Henderson, McDowell, Orange, Polk, Rockingham, Vance, Warren, and Gaston, given in the order of the importance of their productions. Rowan County, which had the largest number of operators (10), was only second in the value of its production. In 1902 Rowan County, with 12 operators, was first in the value of the production. Gaston County, with 2 operators, was lowest in the value of its production, as it was also in 1902, when there were 5 producers. Surry County, in which are located the celebrated Mt. Airy quarries, produced the greatest value of granite. A little over one-third of the granite produced in the State during 1903 was used for building and monumental purposes, which is a decrease of $40,153, as compared with the value of the granite used for the same purposes in 1902. There was a considerable increase in the value of the granite used for road-making and railroad ballast, the total value of the granite used for these purposes being $102,524, an increase of $24,765, as compared with $77,759, the value of the production used for these same purposes in 1902. In the table below are given the different purposes for which the granite quarried in 1901, 1902 and 1903 was used.

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901, 1902 AND 1903.

USES.	1901.	1902.	1903.
Building and monumental purposes	$ 108,574	$ 167,639	$ 127,486
Paving blocks	10,662	6,986	30,780
Curbing and flagging	56,245	82,615	68,099
Crushed stone for road-making, railroad ballast, etc.	89,425	77,759	102,524
Other purposes	-----------	3,750	5,468
Total value	$ 264,906	$ 338,749	$ 334,357

SANDSTONE.

Production.

Although there are good deposits of sandstone occurring in Anson, Moore, Chatham, Durham and Wake counties, this industry has always been small in North Carolina. In 1903 the production of sandstone had decreased to a value of but $600, all of which was used for building purposes. This is a decrease of $4,225, as compared with the value of the production of 1902, which was $4,825, which in turn was a decrease of $6,857, as compared with the production of 1901, which was valued at $11,682.

MARBLE AND OTHER FORMS OF LIMESTONE.

Besides the interest in the marble and limestone deposits in North Carolina to be utilized for building purposes, considerable interest has been shown during the past year regarding these deposits as to the possibility of utilizing them in the manufacture of Portland cement. A number of inquiries have been received from parties outside the State for suitably located deposits of limestone with adjoining clay deposits or of marl deposits which occurred in sufficient quantity to warrant the establishment of a Portland cement manufacturing plant. During the past ten years a very great advance has been made in the utilization of cement in construction work, and this use has not only greatly increased the demand for Portland cement, but also the demand for deposits of the crude materials that are suitable for its manufacture. For this reason attention is called to the various deposits of limestone, marble, shale rock, marl, etc., that are known to occur in the State, with the idea that these deposits may be more thoroughly prospected and developed to prove their extent and the possibility of their utilization for the manufacture of Portland cement. It may also stimulate prospecting of new localities where there is a possibility of locating suitable deposits for this purpose.

The limestone deposits of the State should also be more thoroughly utilized for the burning of lime than they are at the present time, for by far the larger proportion of the lime used in North Carolina is imported from other States, principally from Tennessee and Virginia. The manufacture of lime from North Carolina limestones offers a promising field of investment, as the demand for lime is sure to keep pace with the increase in building and construction work; and there should be a good market for all that would be manufactured in the State. The occurrences of limestone in North Carolina are somewhat varied and widely separated in respect to locality. The deposits occurring in the southeastern counties are more or less admixed with clay and resemble marl. In other sections of these same counties it occurs in the form of a shell rock, such as the deposits that occur on the Northeast Cape Fear, Trent, and other rivers. In still other places it is to be found of a more compact nature, and forming fine-grained limestone rock which, however, has scattered through it here and there fossil shells which are more or less distinct in outline. This limestone rock often grades into a typical shell rock. These shell limestones are found in nearly horizontal beds in the coastal plain formation and are being used to some extent for building purposes, for road, and for harbor improvements. It is easily quarried and hardens sufficiently on exposure to the air to be very serviceable and makes a durable stone for rough, massive work.

The shell rock which occurs on the Northeast Cape Fear river opposite Rocky Point, Pender County, was employed about 14 years ago quite extensively for harbor improvements about Wilmington. This rock is overlain by 1 to 5 feet of soil and marl. Another use that has been made of this particular shell rock is in burning it to lime for agricultural purposes. It contains in certain portions of the rock small nodules of phosphate of lime. To the south of Rocky Point, at Castle Hayne, New Hanover County, there is a similar occurrence of shell rock. The marls overlying these rocks, as well as the shell rocks themselves, have been, during the past year, investigated as to their value in the manufacture of Portland cement.

The shell rock that occurs on Trent river in Craven County is somewhat open in texture and has been used locally for rough building purposes and finished walls. The rock is composed of medium to large sized shells with an admixture of sand, the whole being cemented together with a carbonate of lime. This shell rock forms a durable building material and it can be easily quarried and brought to New Bern on flat-boats.

In the vicinity of Raleigh, Wake County, the limstone has been quarried to some extent, principally for burning to lime. These deposits are worthy of more thorough development and investigation.

In the piedmont counties there are several localities that contain limited deposits of a semi-crystalline limestone, notably those near Germantown, which is along the limestone belt that passes through Catawba, Lincoln, and Gaston counties. The deposits to the south of Bessemer City, Gaston County, offer possibilities of some promise as a suitable location for the manufacture of lime. In the western counties limestone is found in considerable quantities in Henderson, Transylvania, and Madison counties. The limestone in these counties has been utilized to some extent for burning to lime, but it has never been undertaken on a commercial scale, although the limestone makes a good quality of lime of a good white color. In the southern part of Transylvania County, the limestone becomes more siliceous and makes but an impure lime. In Henderson County the principal limestone beds lie about 7 to 10 miles west of Hendersonville in the vicinity of Boilston. In Madison County, limestone of fair quality is found in the vicinity of Hot Springs.

Extensive deposits of marble are found in Swain and Cherokee counties, and in the latter the deposits have been quite extensively developed by the National Marble Company of Murphy, North Carolina. They have taken out a very good quality of a blue-black and blue and white marble which makes a very handsome decorative and monumental stone. It can be obtained in large blocks for columns for building purposes and for shafts for monumental purposes. Its color is very good and this stone should find a ready market. White and pink marble also occur to some extent in this same belt. In Swain County, on the property of Mr. Frank H. Hewitt, of Asheville, N. C., there is a large deposit of marble which is suitably located for quarrying and for railroad transportation. In McDowell County, about 10 miles north of Marion, there is a dolomitic marble which, while usually of a white color, is occasionally distinctly blue. Portions of this stone are well suited for building or ornamental purposes. Nearly all of these marbles would burn to an excellent lime, and, as nearly all the lime used in North Carolina is imported, the waste product obtained in quarrying could be utilized for this purpose and probably with very good financial results.

Production.

There was a production of marble from the Cherokee County deposits by the National Marble Company, which was used for building and monumental purposes, and judging from the work that is being done by this company and the quality of the marble that they are putting on the market, this is but the beginning of an industry that will become of some considerable importance in North Carolina.

The total production of marble and other forms of limestone in North Carolina during 1903 was valued at $25,365, which is an increase of $2,212 as compared with the production for 1902, which was valued at $23,153. The larger proportion of the production was used for road-building and curbing. This production was obtained from Cherokee, New Hanover, and Pender counties, there being no production from Henderson County, which was one of the producers in 1902.

SLATE.

Slate of good quality is known to occur in the vicinity of Egypt, Pittsboro and Goldston, Chatham County, and near Albemarle, Stanly County. It has also been found in Durham and Alamance counties, but its actual value has not yet been determined. Near Mt. Gilead, Montgomery County, a slate quarry is being developed by Mr. J. J. Dun. The deposit, however, is 7 miles from the railroad.

CLAY.

There was a decided increase in the value of the production of clay products, including kaolin, in 1903 over the value of the production of 1902. The value of the 1903 production was $942,458 as compared with $908,105 during the previous year, being an increase of $34,353. The value of the clay products, with the exception of kaolin, in 1903 was $866,458, which is an increase of $66,458 as compared with the value of the production of $800,000 in 1902. This shows a decided increase in the clay industry, but it does not begin to represent the value of what the clay industry could and should be in North Carolina. There should be a much larger increase in the production of clay products, as there are good deposits of clay scattered throughout the State suitable for the manufacture of building brick of good quality that would stand transportation; for decorative brick; and for the manufacture of earthenware, sewer-pipe, terra-cotta, etc. At the present time a large proportion of the better grade of brick used in North Carolina is imported, and this is also true of a great deal of the earthenware, sewer-pipe, terra-cotta, etc.

KAOLIN OR CHINA-CLAY.

Kaolin deposits are known to occur in Jackson, Macon, Swain, and Buncombe counties. The best quality of kaolin, however, is that obtained from Jackson County, and that county has produced by far the largest quantity of any county in the State.

The American Land and Development Company are developing a deposit of kaolin near Barber's Creek Station, Jackson County, N. C., which is on the Asheville and Murphy branch of the Southern Railway. The deposit has been developed by a series of cross-cuts, pits and shafts which indicate that the clay occurs in considerable quantity and it is of good quality. This clay has been analyzed by Mr. F. F. Hunt, of 77 Pine Street, New York City, with the following results:

ANALYSIS OF KAOLIN FROM BARBER CREEK, JACKSON COUNTY.

	PER CENT.
Silica	44.66
Alumina	39.90
Iron	Trace
Alkalies	.68
Moisture	14.28
Total	99.52

In commenting on a sample of this clay sent to the American Encaustic Tiling Company, of Zanesville, Ohio, their superintendent, Mr. George A. Stanbery, made the following statement:

> From the small sample sent us, we took 3 pounds of the clay and heaped it up, passing it through a No. 12 lawn. Twenty-five and one-half ounces of the clay went through the lawn and 22½ ounces refused to go through, which represents the waste. From the appearance of the sample, it looks as if the clay was very good. It shows white.
>
> A fine clay that would furnish large quantities and of the same quality as the small sample sent would be valuable not only in our business, but to the white-ware potters. This clay is similar to that mined by the Harris Clay Company, which is the finest kaolin obtained in the United States.

There are a number of localities in the mountainous sections of North Carolina where kaolin occurs in small quantity, but as the feldspar from which the kaolin has been derived has been decomposed and altered to but a slight depth, these deposits of kaolin are soon worked out and the partially decomposed feldspar is encountered, which does not have the kaolin properties. Occasionally portions of the pegmatitic dike will be decomposed to a much greater depth than other portions and the kaolin will occur in bunches or pockets.

Nearly all of the kaolin that is mined in the State is shipped to the potteries at Trenton, N. J., or East Liverpool, Ohio, where it is utilized for those purposes which require the finest grade of clay. It is used in the manufacture of tiling; for the better grades of porcelain, and for the enamelling of brick. All those materials and others, such as electric porcelain insulators, etc., are imported into the State and sometimes have been made of the clay that has been exported. There should be a profitable investment in the utilization of these kaolins and similar clays for the manufacture of electric porcelain insulator goods and pottery, all of which are now being imported into the State. In many sections we have the clay, the quartz and the feldspar required for the manufacture of these various clay products; and also good water-power that could be utilized in manufacturing them.

Production.

In 1903 all of the production of kaolin in the State was from Jackson County. Swain and Buncombe, which reported small productions in 1902, made none in 1903. The total quantity of kaolin mined in 1903 was 8,605 tons, valued at $76,000, which is a decrease of 4,717 tons in quantity and of $32,105 in value as compared with the production in 1902 of 13,322 tons, valued at $108,105. The average value per ton of the 1903 production was $8.83, which is an increase of 72 cents per ton as compared with the average value of $8.11 per ton of the 1902 production.

POTTERY-CLAY.

Production.

There was a slight falling off in the value of the production of pottery in North Carolina during 1903, and the total value of this production of red earthenware and stoneware was only $14,312, which is a decrease of $200 as compared with $14,512, the value of the production of 1902. There were 23 pottery manufacturers who aided in this production, and these were located in the following 8 counties, given in the order of the importance of their productions: Lincoln, Catawba, Buncombe, Chatham, Randolph, Wilkes, Union, and Jackson. In 1902 there were 28 pottery manufacturers located in the same 8 counties. There was no decorative ware reported as having been made in 1903. Of the 1903 production, $612 was the value of the red earthenware, and $13,700 of the stoneware. With improved methods and by exercising more care in the manufacture, and by using better material for glazing the ware, North Carolina potters would be able to put a far better grade of pottery on the market with but little or no more expense, and this would sell at a considerably increased price. The values of the different grades of pottery produced in the various counties during 1901, 1902 and 1903 are given in the following table:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES IN 1901, 1902 AND 1903

County.	1901.				1902.			1903.		
	Earthen-ware.	Stone-ware.	Decorative ware, etc.	Total.	Earthen-ware.	Stone-ware.	Total.	Earthen-ware.	Stone-ware.	Total.
Buncombe	$ 280	$ 3,100	$-------	$ 3,320	$ 150	$ 1,850	$ 2,010	$ 60	$ 2,200	$ 2,260
Catawba	--------	2,540	--------	2,540	55	4,410	4,465	------	3,155	3,155
Chatham	--------	2,700	--------	2,700	------	2,000	2,000	------	2,000	2,000
Cumberland	60	--------	--------	60	------	--------	--------	------	--------	--------
Johnston	525	1,700	--------	2,225	40	525	565	80	255	335
Lincoln	2,500	2,000	25	4,525	25	2,900	2,925	100	3,270	3,370
Randolph	860	3,173	200	4,233	28	769	797	222	1,320	1,542
Union	325	1,040	27	1,392	300	300	600	100	400	500
Warren	--------	--------	300	300	------	--------	--------	------	--------	--------
Wilkes	--------	1,200	--------	1,200	50	1,100	1,150	50	1,100	1,150
Total	$ 4,490	$ 17,453	$ 542	$22,495	$ 658	$13,854	$14,512	$ 612	$13,700	$ 14,312

FIRE-CLAY AND PIPE-CLAY.

Production.

There was a very decided increase in the production of fire-clay and pipe-clay products during 1903, and this increase was for the most part in connection with the manufacture of tiling and the better grades of sewer-pipe. The total value of all fire-clay and pipe-clay products reported in 1903 was $107,114, this including fire-brick, fire-clay sold crude, sewer-pipe, tile, etc. This is an increase of $33,078 in value as compared with $74,036, the value of the production of 1902. This in turn was an increase of $16,576 in value as compared with the value of the production of 1901, which was $56,395. This continued increase in the production of these clay products illustrates what can be accomplished in the manufacture of the better grade of clay products, but this production should increase many times more, as the demand for these products in the State fully warrants this.

Of the 1903 production, $5,250 was the value of 407,500 fire-brick, which is an increase of 322,500 fire-brick in quantity and of $4,047 in value as compared with the production of 1902 of 85,000 fire-brick, valued at $1,203. There was also a small amount of crude fire-clay sold in 1903, amounting to 231 tons, valued at $875. In 1902 the value of the crude fire-clay sold was $215.

The most noticeable increase in the production of these clay proucts was sewer-pipe, tile, etc., whose value in 1903 was $107,114, vhich is an increase of $34,496 as compared with $72,618, the value f the production in 1902. This in turn was an increase of $16,873 s compared with $55,745, the value of the production in 1901. Alhough there has been this decided increase since 1901, the production oes not begin to represent the increase that there should be in this ndustry in North Carolina.

BRICK-CLAY.

There are clay deposits suitable for the manufacture of brick ocurring in the greater number of counties throughout North Caroina, and in a number of these the clay is of such quality that it is apable of being used in the manufacture of pressed brick, front brick r decorative brick, which should find a ready market throughout the State and also in adjoining States. In order, however, to utilize hese clays for this purpose, more attention will have to be given to details in the manufacturing of the brick than is being done at the resent time in order to put a better made brick on the market, and ne which is not only more attractive in appearance, but also capable f standing transportation and rough handling. While there is but ittle margin of profit in the manufacture of the cheaper grades of rick, there is a good margin of profit in the manufacture of the beter quality of bricks, such as pressed brick and decorative brick. Conractors throughout the State are constantly attempting to utilize or the manufacture of brick clays found in the vicinity of where they re erecting buildings; and often the bricks that are made will hardly old together long enough to be laid during the course of the construcon of the building. In a number of instances brick that were being sed in the construction of public as well as private buildings have een examined, which, if there had been any inspector of buildings, ould have been thrown out as totally unfit for any use in construcon. It is not always the fault of the clay that such poor brick are ade, but due to the poor methods used in the manufacture of the rick and often to the unskilled labor employed.

Production.

During 1903 brick were manufactured in 62 counties, which is 5 less than in 1902. Seven counties, Franklin, Granville, Hertford, Person, Vance, Warren, and Yadkin, which reported a production of brick during 1902, reported none in 1903, while Ashe and Jackson counties, which made no production in 1902, were producers of brick in 1903. The total number of all kinds of brick, except fire-brick, made during 1903 amount to 138,088,900, valued at $745,032, this being an average value of $5.39 per thousand. This production is an increase of 4,537,200 brick in quantity and of $33,580 in value as compared with the production of 133,551,700 brick, valued at $711,452 in 1902.

Of the 1903 production there were 136,822,900 common brick, valued at $731,802, which is an increase of 5,211,200 brick in quantity and of $36,975 in value as compared with the production of 131,611,700 common brick, valued at $694,827, in 1902. The number of pressed brick manufactured in 1903 were 766,000, valued at $8,230, and of vitrified brick, 500,000, valued at $5,000. In the table below are given the quantity and value of the common, pressed and vitrified brick produced in 1901, 1902 and 1903:

PRODUCTION OF COMMON, PRESSED, VITRIFIED AND FIRE-BRICK IN 1901, 1902 AND 1903.

CHARACTER.	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	134,441,570	$697,861	131,618,700	$694,827	136,822,900	$ 731,802
Pressed brick	1,095,000	10,220	1,833,000	10,625	766,000	8,230
Vitrified brick	180,000	1,650	600,000	6,000	500,000	5,000
Fire-brick	55,000	550	120,000	1,203	407,500	5,250
Total	135,771,570	$710,281	134,171,700	$712,655	138,496,400	$ 750,282

There was also a slight increase in the average value per thousand of the 1903 production as compared with the average value of $5.33 per thousand of the 1902 production, this being an increase of 6 cents per thousand. As compared with the 1901 production the increase in the average value per thousand is 16 cents, the average rice received in 1901 being $5.23 per thousand. The number of nanufacturers engaged in making brick during 1903 was 171, which is 24 less than the number (195) engaged in this business in 1902. This in turn was 36 less than the number (231) in 1901. The low-est value per thousand reported as having been received for brick luring 1903 was $3.50 and the highest $10, this latter value being for vitrified brick, as compared with $3.75 and $10, which were the owest and highest prices received respectively for brick during 1902. The highest price reported as having been received for common brick vas $8 per thousand, the same as reported in 1902. This value vas received for a small production made in Washington County. In the following tables are given the total number and value of the lifferent varieties of brick, including fire-brick, manufactured in 903 and 1902 by counties:

UMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1903 BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE-BRICK.	VALUE.
lamance	2,750,000	$ 15,250		$		$
nson	1,000,000	5,500				
she	300,000	1,500				
eaufort	1,323,000	8,200				
ertie	4,600,000	21,000				
laden	200,000	1,100				
uncombe	4,305,900	22,686	150,000	2,250	365,500*	5,100
urke	400,000	1,600				
abarrus	5,010,000	25,055	100,000	1,000		
aldwell	1,500,000	5,250				
arteret	150,000	900				
atawba	1,920,000	9,680				
hatham					2,000†	20
howan	1,000,000	7,000				
leveland	975,000	5,320	200,000	2,000		
olumbus	2,000,000	10,000				
raven	6,000,000	47,750				
umberland	1,750,000	9,500				
avidson	500,000	2,500				
uplin	50,000	278				
urham	6,710,000	36,210				
dgecombe	5,450,000	32,700				
orsyth	8,505,000	44,625	150,000	1,500		
aston	2,670,000	14,350				
ates	105,000	375				
reene	635,000	4,445				

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1903 BY COUNTIES—CONTINUED.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE-BRICK.	VALUE.
Guilford	8, 188, 000	$ 44, 817		$		$
Halifax	3, 400, 000	19, 500	70, 000	600		
Harnett	2, 500, 000	10, 800				
Haywood	700, 000	3, 990				
Henderson	1, 000, 000	5, 000			500, 000*	5, 000
Iredell	3, 200, 000	15, 900				
Jackson	70, 000	420				
Johnston	1, 730, 000	10, 350				
Lenoir	1, 000, 000	6, 500				
Lincoln	830, 000	4, 150				
McDowell	2, 900, 000	14, 500				
Martin	8, 000	48				
Mecklenburg	2, 300, 000	14, 000				
Montgomery	282, 000	1, 403				
Moore	2, 682, 000	13, 687				
Nash	1, 000, 000	5, 500				
New Hanover	2, 750, 000	16, 500				
Orange	1, 000, 000	4, 950			30, 000†	30
Pasquotank	1, 800, 000	10, 800				
Pitt	1, 240, 000	7, 458				
Randolph	780, 000	3, 742			10, 000†	100
Robeson	352, 000	2, 103	14, 000	124		
Rockingham	3, 216, 000	18, 860				
Rowan	2, 500, 000	13, 500				
Rutherford	650, 000	3, 340				
Sampson	50, 000	250				
Scotland	600, 000	3, 300				
Stanly	300, 000	1, 200				
Surry	1, 210, 000	5, 755	50, 000	500		
Transylvania	95, 000	500				
Union	3, 437, 000	15, 555				
Wake	5, 166, 000	26, 095				
Washington	30, 000	240				
Wayne	9, 150, 000	51, 075				
Wilkes	1, 598, 000	7, 990	32, 000	256		
Wilson	6, 300, 000	35, 250				
Total	136, 822, 900	$ 731, 802	766, 000	$ 8, 230	907, 500	$ 10, 250

*Vitrified brick.

†Fire-brick.

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1902.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Alamance	5, 220, 000	$ 24, 075		$		$
Anson	600, 000	3, 500				
Beaufort	1, 440, 000	9, 000				
Bertie	3, 616, 000	18, 635	500, 000	4, 000		
Bladen	400, 000	2, 000				
Buncombe	4, 750, 000	23, 978				
Burke	1, 700, 000	6, 800				
Cabarrus	85, 000	425				
Caldwell	1, 260, 000	5, 720				
Carteret	990, 000	500				
Catawba	477, 000	2, 072				
Chatham	100, 000	500				
Chowan	1, 000, 000	7, 000				
Cleveland	1, 258, 000	6, 148				
Columbus	1, 200, 000	6, 000				
Craven	4, 500, 000	22, 500				
Cumberland	3, 000, 000	15, 000				
Davidson	2, 320, 000	13, 000				
Duplin	263, 700	1, 458				
Durham	5, 050, 000	25, 825				
Edgecombe	4, 050, 000	23, 500				
Forsyth	3, 442, 000	15, 423				
Franklin	200, 000	1, 400				
Gaston	1, 725, 000	7, 845				
Gates	105, 000	430				
Granville	800, 000	6, 000				
Greene	910, 000	5, 478				
Guilford	8, 802, 000	44, 160	240, 000	1, 900		
Halifax	4, 050, 000	23, 500	175, 000	1, 575		
Harnett	2, 400, 000	9, 900				
Haywood	400, 000	2, 200				
Henderson	1, 000, 000	6, 000	30, 000	450	600, 000	6, 000
Hertford	140, 000	880	140, 000	880		
Iredell	1, 500, 000	8, 050				
Johnson	570, 000	3, 600				
Lenoir	3, 000, 000	18, 500				
Lincoln	300, 000	1, 500				
McDowell	900, 000	5, 300				
Martin	19, 000	105				
Mecklenburg	2, 765, 000	14, 418				
Montgomery	300, 000	1, 500	80, 000	650		
Moore	1, 650, 000	7, 200				
Nash	2, 000, 000	11, 000				
New Hanover	1, 000, 000	5, 500				
Orange	370, 000	1, 630				
Pasquotank	1, 650, 000	9, 575				
Person	6, 000, 000	36, 000				
Pitt	1, 728, 000	11, 122				
Randolph	1, 590, 000	7, 550				
Robeson	625, 000	3, 780				
Rockingham	4, 447, 000	22, 267				
Rowan	1, 800, 000	10, 500				
Rutherford	200, 000	850				
Sampson	100, 000	500				

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1902—Continued.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED BRICK.	VALUE.
Scotland	500,000	$ 2,500		$		$
Stanly	500,000	2,570				
Surry	1,115,000	5,955				
Transylvania	600,000	3,000				
Union	900,000	4,685				
Vance	100,000	700				
Wake	5,215,000	26,573	50,000	450		
Warren	100,000	500				
Washington	160,000	1,100				
Wayne	13,850,000	70,350				
Wilkes	1,325,000	6,380	115,000	690		
Wilson	8,333,000	48,950				
Yadkin	53,000	265	33,000	30		
Total	131,618,700	$694,827	1,333,000	$ 10,625	600,000	$ 6,000

As is seen from the above table of the production of brick in 1903, of the 97 counties in North Carolina only 62 reported any production of brick. The county to produce the largest number of brick in 1903 was Wayne, whose production was 9,150,000, valued at $51,075. This county was also the largest producer in 1902, when its production amounted to 13,850,000, valued at $70,350, this being 4,700,000 more than in 1903. Forsyth County was second in 1903, with a production of 8,655,000 brick, valued at $46,125. Guilford County, which was second in 1902, with a production of 9,042,000, valued at $46,060, was third in 1903, with a production of 8,188,000 brick, valued at $44,817. The county producing the smallest number of common brick was Martin, which reported a production of only 8,000, valued at $48. This county was also the smallest producer in 1902, when the production reported amounted to 19,000 brick, valued at $105. There is given in the table below the quantity and value of all the clay products produced in North Carolina in 1901, 1902 and 1903. The above statistics regarding the clay production of the State does not, perhaps, represent the output in its entirety, for the reason that in a number of the mountain counties there are a few thousand brick occasionally made for local purposes, regarding which it is difficult or impossible to obtain any statistics.

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN 1901, 1902 AND 1903.

	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	134,441,570	$697,861	131,611,700	$694,827	136,822,900	$ 731,802
Pressed brick	1,095,000	10,220	1,233,000	10,625	766,000	8,230
Vitrified brick	180,000	1,650	600,000	6,000	500,000	5,000
Fire-brick	55,000	550		1,203	407,500	5,250
Earthenware		4,490		658		612
Stoneware		17,453		13,854		13,700
Decorated ware		552				
Sewer-pipe, tile, etc.		55,745		72,618		100,989
	TONS.		TONS.		TONS.	
Kaolin	15,575	119,172	13,322	108,105	8,605	76,000
Fire-clay		100		215	231	875
Total value		$907,793		$908,105		$ 942,458

In the folowing table there is given the total mineral production of the State for the years 1900 to 1903, inclusive:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1900, 1901, 1902 AND 1903.

MINERAL.	VALUE.			
	1900.	1901.	1902.	1903.
Gold	$ 46,653	$ 60,411	$ 93,650	$ 113,604
Silver	15,986	34,024	30,212	16,907
Copper	41,600	76,900	212,553	67,037
Iron	42,000	4,997	52,771	78,540
Pyrite	14,625	32,000		
Garnet	18,000	43,000	10,040	12,250
Corundum	36,840	48,840		
Millstones			1,425	902
Mica Sheet	65,200	79,849	81,653	86,300
Mica Scrap	36,262	14,200	2,919	2,400
Quartz		7,500	11,250	36,827
Precious stones	12,020	24,245	5,300	1,525
Rare minerals			60	270
Monazite	48,805	59,262	64,160	58,694
Zircon			360	570
Barytes		22,615	44,130	21,347
Talc and pyrophyllite	42,000	77,974	88,962	76,984
Graphite		559	4,300	248
Coal	22,500	5,585	24,500	25,300
Stone	285,172	284,744	366,727	360,322
Kaolin	62,440	119,172	108,105	76,000
Clay products	815,975	788,618	800,000	866,458
Total value	$1,604,078	$1,779,109	$2,003,077	$ 1,902,485

As is seen from the above table, there was a slight falling off in the total value of $1,902,485 of the mineral production for 1903 as compared with that of $2,003,077 for 1902, this decrease amounting to $100,592. There were 78 counties of the 97 in the State from which the mineral production of 1903 was obtained, and in the following table the value of the production for each county is given. The value of the clay products, with the exception of kaolin, which is included with the other minerals, is given separately from the rest of the mineral production.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1902 AND 1903.

COUNTY.	1902.			1903.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Alamance	$	$24,075	$ 24,075	$	$ 15,250	$ 15,250
Alexander	200		200	50		50
Alleghany						
Anson		4,250	4,250	600	5,500	6,100
Ashe				1,000	1,500	2,500
Beaufort		9,500	9,500		8,200	8,200
Bertie		22,653	22,653		21,300	21,300
Bladen		2,018	2,018		1,100	1,100
Brunswick						
Buncombe	18,375	27,463	45,838	14,566	32,371	46,957
Burke	10,238	6,800	17,038	12,629	1,600	14,229
Cabarrus	10,650	425	11,076	3,323	26,055	29,378
Caldwell	19	5,720	5,739	42	5,250	5,292
Camden						
Carteret		500	500		900	900
Caswell						
Catawba	8,336	6,562	14,898	7,060	12,835	19,895
Chatham	24,630	2,500	27,130	27,523	2,000	29,523
Cherokee	21,952		21,952	50,116		50,116
Chowan		7,000	7,000		7,020	7,020
Clay	200		200	297		297
Cleveland	16,000	6,148	22,148	19,969	7,320	27,289
Columbus		6,000	6,000		10,000	10,000
Craven		22,500	22,500		47,750	47,750
Cumberland	19	15,000	15,019		9,500	9,500
Currituck						
Dare						
Davidson	27,971	13,000	40,971	672	2,500	3,172
Davie						
Duplin		1,458	1,458		278	278
Durham		25,825	25,825		36,210	36,210

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1902 AND 1903—Continued.

COUNTY.	1902.			1903.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Edgecombe	$ -------	$ 23,500	$ 23,500	$ -------	$ 32,700	$ 32,700
Forsyth	3,057	15,623	18,680	-------	46,401	46,401
Franklin	632	1,400	2,032	165	-------	165
Gaston	8,874	7,845	16,719	1,112	14,350	15,462
Gates	-------	430	430	-------	375	375
Graham	-------	-------	-------	-------	-------	-------
Granville	3,996	6,000	9,996	5,477	-------	5,477
Greene	-------	5,478	5,478	-------	4,445	4,445
Guilford	966	117,560	118,526	3,966	144,817	148,783
Halifax	1,356	25,075	26,431	426	20,100	20,526
Harnett	-------	9,900	9,900	-------	10,800	10,800
Haywood	20,850	2,200	23,050	18,560	3,990	22,550
Henderson	16,201	12,450	28,651	17,589	10,800	28,389
Hertford	-------	1,760	1,760	-------	-------	-------
Hyde	-------	-------	-------	-------	-------	-------
Iredell	434	8,050	8,484	160	15,900	16,060
Jackson	119,905	-------	119,905	94,646	420	95,066
Johnston	475	4,165	4,640	15,000	10,685	25,685
Jones	-------	-------	-------	-------	-------	-------
Lenoir	-------	18,500	18,500	-------	6,500	6,500
Lincoln	9,845	4,425	14,270	15,256	7,520	22,776
McDowell	42,715	5,300	48,015	34,690	14,500	49,190
Macon	6,344	-------	6,344	3,749	-------	3,749
Madison	42,630	-------	42,630	26,447	-------	26,447
Martin	-------	105	105	-------	48	48
Mecklenburg	21,300	14,418	35,718	8,682	14,000	22,682
Mitchell	79,319	-------	79,319	93,127	-------	93,127
Montgomery	39,173	2,150	41,323	49,513	1,403	50,916
Moore	13,937	7,200	21,137	7,769	13,687	21,456
Nash	299	11,000	11,299	142	5,500	5,642
New Hanover	21,063	5,500	26,563	20,400	16,500	36,900
Northampton	-------	-------	-------	-------	-------	-------
Onslow	-------	-------	-------	-------	-------	-------
Orange	5,462	1,648	7,110	27,781	4,980	32,761
Pamlico	-------	-------	-------	-------	-------	-------
Pasquotank	-------	9,575	9,575	-------	10,800	10,800
Pender	470	-------	470	600	-------	600
Perquimans	-------	-------	-------	-------	-------	-------
Person	157,010	36,000	193,010	71,316	-------	71,316
Pitt	-------	11,122	11,122	-------	7,458	7,458
Polk	1,339	-------	1,339	7,507	-------	7,507
Randolph	1,076	8,547	9,623	403	5,797	6,200
Richmond	-------	-------	-------	-------	-------	-------
Robeson	-------	3,780	3,780	-------	2,227	2,227
Rockingham	-------	22,267	22,267	10,200	18,860	29,060
Rowan	187,777	10,500	198,277	112,573	13,500	125,073
Rutherford	18,269	850	19,119	12,344	3,340	15,680
Sampson	-------	500	500	-------	250	250
Scotland	-------	2,500	2,500	-------	3,300	3,300

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1902 AND 1903—CONTINUED.

COUNTY.	1902.			1903.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Stanly	$ 867	$ 2,570	$ 3,437	$ 24,640	$ 1,200	$ 25,840
Stokes	1,000	----------	1,000	7,740	----------	7,740
Surry	116,965	----------	116,965	111,462	6,255	117,717
Swain	74,187	----------	74,187	53,150	----------	53,150
Transylvania	780	3,100	3,880	516	500	1,016
Tyrrell	----------	----------	----------	----------	----------	----------
Union	754	5,285	6,039	3,198	16,055	19,253
Vance	17,554	700	18,254	$14,750	----------	14,750
Wake	9,200	27,023	36,223	248	26,095	26,343
Warren	121	500	621	751	----------	751
Washington	----------	1,100	1,100	----------	240	240
Watauga	----------	----------	----------	----------	----------	----------
Wayne	----------	70,350	70,350	----------	51,075	51,075
Wilkes	----------	8,220	8,220	----------	9,396	9,396
Wilson	----------	48,950	48,950	----------	35,250	35,250
Yadkin	----------	295	295	----------	----------	----------
Yancey	22,159	----------	22,159	20,600	----------	20,600
Unknown	1,030	----------	1,030	1,525	----------	1,525
Total value	$1,203,077	$800,000	$2,003,077	$866,458	$1,036,027	$ 1,902,485

Of the 78 counties reporting a mineral production for 1903, there were only 48 counties that reported anything besides clay products. There were 62 counties reporting a production of clay, of which 29 counties did not report any other mineral production. There were 14 counties reporting a mineral production, but none of clay products. The number of counties producing both clay and other mineral products was 34. There were 19 counties that did not report the production of any mineral whatever during 1903. The county reporting the greatest value for its mineral production, except clay products, was Rowan, the value being $112,573. The county producing the greatest value of clay products was Guilford, the value being $144,817. The county whose total mineral production was greatest in value in 1903 was Guilford, the value being $148,783. Rowan County is second in the valuation with a production valued at $125,073. The lowest value reported by any county was $48, which was the value of the mineral production of Martin County.

PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

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THE NORTH CAROLINA GEOLOGICAL SURVEY

Economic Paper No. 9

THE MINING INDUSTRY

IN

NORTH CAROLINA DURING 1904

BY

JOSEPH HYDE PRATT, Ph. D.
MINERALOGIST

RALEIGH
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LETTER OF TRANSMITTAL.

Raleigh, N. C., August 15, 1905.

To *his Excellency*, Hon. R. B. Glenn,
Governor of North Carolina.

Sir:—I herewith have the honor to submit for publication as Economic Paper No. 9, a report on the Mining Industry in North Carolina for the year 1904. In this report are taken up the statistics of production of the various minerals that were mined in the State during 1904; it also gives full descriptions of the occurrence of ome of the minerals which have not been described before, and also alls attention to new deposits that may be of economic importance.

I am, with great respect,

Yours very truly,

J. A. Holmes,
State Geologist.

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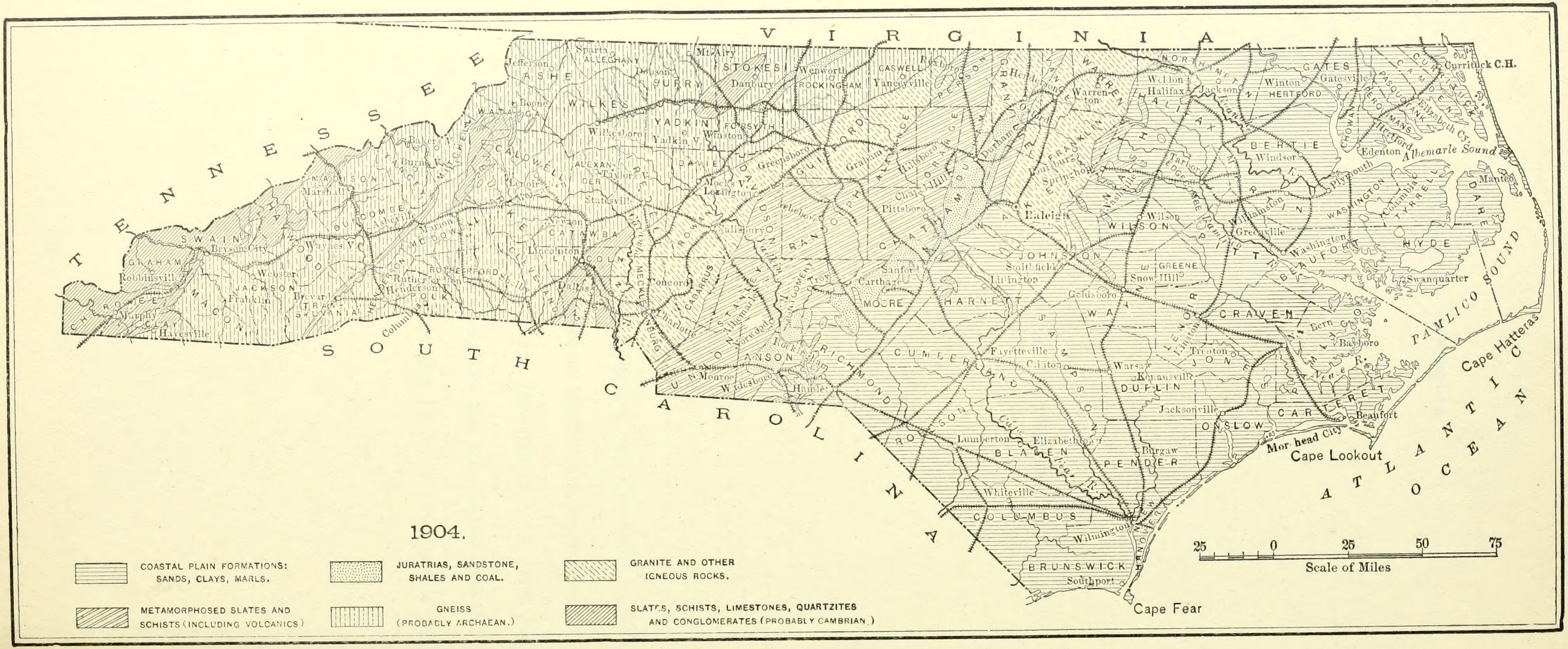1904.
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN.)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN.)
Scale of Miles
25
0
25
50
75
VIRGINIA
TENNESSEE
SOUTH CAROLINA
ATLANTIC OCEAN
Albemarle Sound
PAMLICO SOUND
Cape Hatteras
Cape Lookout
Cape Fear
Currituck C.H.
CURRITUCK
CAMDEN
PASQUOTANK
Elizabeth Cy.
PERQUIMANS
Hertford
CHOWAN
Edenton
GATES
Gatesville
Winton
HERTFORD
NORTHAMPTON
Jackson
Weldon
Halifax
HALIFAX
BERTIE
Windsor
WASHINGTON
Plymouth
TYRRELL
Columbia
DARE
Manteo
HYDE
Swanquarter
BEAUFORT
Washington
MARTIN
Williamston
PITT
Greenville
EDGECOMBE
Tarboro
NASH
Nashville
WILSON
Wilson
GREENE
Snow Hill
WAYNE
Goldsboro
LENOIR
Kinston
CRAVEN
New Bern
PAMLICO
Bayboro
Neuse R.
JONES
Trenton
CARTERET
Beaufort
Morehead City
ONSLOW
Jacksonville
DUPLIN
Kenansville
Warsaw
PENDER
Burgaw
NEW HANOVER
Wilmington
BRUNSWICK
Southport
COLUMBUS
Whiteville
BLADEN
Elizabethtown
Cape Fear R.
ROBESON
Lumberton
SAMPSON
Clinton
CUMBERLAND
Fayetteville
HARNETT
Lillington
JOHNSTON
Smithfield
WAKE
Raleigh
FRANKLIN
Louisburg
Springhope
WARREN
Warrenton
VANCE
Henderson
GRANVILLE
Oxford
PERSON
Roxboro
DURHAM
Durham
ORANGE
Hillsboro
Chapel Hill
CHATHAM
Pittsboro
MOORE
Sanford
Carthage
RICHMOND
Rockingham
Hamlet
ANSON
Wadesboro
UNION
Monroe
MONTGOMERY
Troy
STANLY
Albemarle
Norwood
RANDOLPH
Asheboro
ALAMANCE
Graham
CASWELL
Yanceyville
ROCKINGHAM
Wentworth
GUILFORD
Greensboro
DAVIDSON
Lexington
Yadkin R.
ROWAN
Salisbury
CABARRUS
Concord
MECKLENBURG
Charlotte
Catawba R.
GASTON
Dallas
LINCOLN
Lincolnton
CATAWBA
Newton
IREDELL
Statesville
DAVIE
Mocksville
FORSYTH
Winston
STOKES
Danbury
SURRY
Mt. Airy
Dobson
YADKIN
Yadkinville
WILKES
Wilkesboro
ALLEGHANY
Sparta
ASHE
Jefferson
WATAUGA
Boone
ALEXANDER
Taylorsville
CALDWELL
Lenoir
BURKE
Morganton
CLEVELAND
Shelby
RUTHERFORD
Rutherfordton
POLK
Columbus
McDOWELL
Marion
MITCHELL
Bakersville
YANCEY
Burnsville
MADISON
Marshall
BUNCOMBE
Asheville
HENDERSON
Hendersonville
TRANSYLVANIA
Brevard
HAYWOOD
Waynesville
JACKSON
Webster
SWAIN
Bryson City
GRAHAM
Robbinsville
MACON
Franklin
CHEROKEE
Murphy
CLAY
Hayesville

MINING INDUSTRY IN NORTH CAROLINA DURING 1904.

By JOSEPH HYDE PRATT.

INTRODUCTION.

The mining and quarrying industries of North Carolina are at the present time in a more prosperous and substantial condition than ever in the history of the State. These conditions have been brought about by the introduction of more systematic methods of mining; by the more conservative management of companies operating mines; by a more comprehensive knowledge of the mineral resources of the State; and by reason of better transportation facilities. There is a continued interest in the mineral deposits of North Carolina and new companies are constantly being organized for the development of these properties. In some instances the properties developed do not prove to be of economic importance, yet others develop into good, dividend-paying propositions.

From year to year there is a considerable change noted in the production of the various minerals in the State, and with some it is first greater and then less than the previous years, while with others of the mineral products it has been a constant increase in the value of the production for a number of years. With others of the minerals there has been an increase in the quantity of the mineral or ore mined, but a falling off in value, due to the lower price of the metal or mineral.

For the past four or five years there has been a constant increase in the production of gold and silver, and during 1904, while the increase was not large, it showed that the gold-mining industry in North Carolina was steadily advancing. This is realized more pronouncedly when consideration is given to the development work that has been carried on by a number of companies who have not tried to make any output of ore beyond the little that is obtained in the direct opening up of the property, but which do have large ore reserves in sight and are holding the ore until their reduction works shall be built for treating the same. Thus, the Whitney Company, of Salisbury and Gold Hill, Rowan County, who have, by their development work, blocked out a very large body of ore, have treated but little of their ore, and are holding this until the completion of their operations at the Narrows of the Yadkin, where will be erected their reduction plant.

Of the two minerals for which North Carolina is especially noted, mica and monazite, there was a decided increase in the value of the productions of 1904 over that of 1903; while with the iron and copper ores and talc and soapstone there was a corresponding decrease in the value of the production. The stone industry, which plays a very important part in the mining industry of North Carolina, showed a slight falling off in value during 1904.

The largest mineral industry in the State is the production of clay products, and for the past three or four years there has been a constant increase in the value of the production of these products in the State. Although there has been this increase in the value of the production, there has not been a corresponding increase in the methods of mining and manufacturing of the clay products which is warranted by the amount of these products used in the State. At the present time about one-half of the total mineral production of the State is of kaolin and other clay products.

The tin deposits of the State have attracted considerable attention during the past year and a bulletin has been published by the Survey descriptive of these deposits as Bulletin No. 19.

There are a number of new railroads or extensions that are being built in the State which will open up portions of counties containing considerable mineral wealth, as the road running from Erwin, Tennessee, to Spruce Pine, Mitchell County, and which is being vigorously pushed toward Marion, McDowell County; another is a continuation of the road from Johnson City, Tenn., to Cranberry, N. C., which has been extended to Kawana, Mitchell County; and a third is in the southern part of the State, which is an extension from Tallulah Falls, Ga., to Franklin, Macon County. This road has now reached the State line and grading has begun down the Little Tennessee River toward Franklin. All of these three railroads will cause the opening up of mineral deposits and timber lands and should result in an increased production of minerals and ores from these counties.

North Carolina State Library.

The total value of the mineral production of North Carolina during 1904 was $1,946,273, as compared with $1,902,485 in 1903, which is an increase of $43,788. The minerals and ores that have been mined in North Carolina during 1904 are given below in the order in which they are discussed in the following pages: Gold and Silver, Copper, Iron, Tin, Abrasive Materials (Corundum, Garnet, Millstones), Mica, Quartz, Barytes, Monazite and Zircon, Rare Minerals, Talc and Soapstone, Precious Stones, Graphite, Coal, Stone, Kaolin and Clay Products.

GOLD AND SILVER.

There were over 400 localities in North Carolina that have been mined for gold and silver, and, while many of these have been worked to but a very limited extent, a number of them have been the scene of large mining operations or extensive development work. In 1904, the localities worked were situated in 34 different counties as compared to 31 counties in 1903. The additional counties in 1904 from which there was a production of gold and silver were Alamance, Anson and Chatham. Development work has been carried on extensively at a number of mines which made little or no production during 1904, but which have succeeded in blocking out large bodies of ore which can be mined cheaply and readily and will within the next year or two be producing gold on a large scale. This is true of the property of the Whitney Company, who are developing gold properties in the vicinity of Gold Hill, Rowan County. The largest production of gold was from Montgomery County, the Iola mine being the chief producer, while the largest amount of silver was obtained from Rowan County, which was also by far the largest producer of copper ores. The fineness of the North Carolina gold is very high, as is indicated by the very small amount of silver that is obtained alloyed with it in mining for gold. This is well indicated when it is considered that in Montgomery County there was over $50,000 worth of gold produced, while the silver obtained from these gold ores only amounted to $901 in value. Most of the silver is obtained as a by-product in copper mining, there being no mines in the State that are worked exclusively or primarily for silver. The bulk of the production of gold in North Carolina in 1904 was from Cabarrus, Catawba, Guilford, Montgomery, Stanly and Union counties; while the silver was obtained principally from Rowan, Person and Granville counties, these latter three being also the counties from which the copper ores are obtained.

It is interesting to note the erection of the cyanide plants at the Colossus (Howie mine), the Southern Homestake mine of Randolph County, and at the Iola mine in Montgomery County. The latter is a 20-ton plant and has been adapted for treatment of tailings from the mill. The other two are of larger capacity. During 1904 there was but little opportunity to work these mills, so that the production by cyaniding was not very large, amounting to a little over $7,000. A cyanide plant has also been erected at the Miami mine of Cabarrus County, which was not operated in 1904, but a chlorination plant was used which, for these ores, as far as could be learned, gave better satisfaction. The work that has been done on the various North Carolina ores in experimenting with the cyanide and chlorination processes has shown that many of the ores are very susceptible to the cyanide process and others can be more profitably treated by the chlorination process.

In mining gold and silver in North Carolina during 1904 three different systems were conducted: (1) ordinary mining by a system of shafts, drifts, tunnels, cross-cuts, etc.; (2) by operating placer deposits by ordinary hydraulic methods; and (3) by dredging certain of the river bottoms. This latter method added but little to the value of the production, the greater amount being obtained from deep mines, the ore from which was crushed and run through stamp mills. A certain amount of gold and nearly all the silver were obtained from the reduction of copper ores.

The principal properties from which most of the gold and silver were obtained during 1904 numbered 39, and were located in 1 different counties. In the table below there is given a list of these mines, and the counties in which they are located, for the years 190 and 1904:

PRINCIPAL MINES PRODUCING GOLD AND SILVER DURING 1903 AND 1904.

NAME OF MINE.	COUNTY.	YEAR.
Boger	Cabarrus	1903—
Miami (formerly Phœnix)	Cabarrus	1903—1904
Shuford	Catawba	1903—1904
M. Ramsay	Cherokee	1903—
Norlina	Davidson	1903—1904*
Blue Wing *(a)*	Granville	1903—1904
Portis	Franklin	1903—1904
Deep River	Guilford	1903—1904*
Fentress	Guilford	1903—1904
Gardner	Guilford	1903—1904*
Lindsay	Guilford	1903—1904
McCullough	Guilford	1903—
Farley Dredge	Halifax	—1904
Vein Mountain	McDowell	1903—1904*
Capps Hill	Mecklenburg	1903—1904
Rudisill	Mecklenburg	—1904
St. Catherine	Mecklenburg	—1904
Surface Hill	Mecklenburg	1903—1904
Summerville or Wilhelmina	Mecklenburg	1903—1904*
Iola	Montgomery	1903—1904
Montgomery	Montgomery	1903—1904
Russell	Montgomery	1903—1904
Alden & Merrill	Moore	1903—1904*
Mann-Arrington	Nash	1903—1904
Holloway *(a)*	Person	1903—1904
Tingen *(a)*	Person	1903—1904
Yancey *(a)*	Person	1903—1904
Lilian	Polk	1903—1904
Cid	Randolph	1903—
Sawyer or Stillwater	Randolph	1903—1904*
Gold Hill *(a)*	Rowan	1903—1904
Whitney (formerly McMakin)	Rowan	1903—1904
Union *(a)*	Rowan	1903—1904
Barringer	Stanly	1903—1904
Ingram or Crawford	Stanly	1903—1904
Parker	Stanly	1903—1904
Colossus (formerly Howie)	Union	1903—1904
Indian Trail (formerly Black)	Union	1903—1904
Moore	Union	1903—1904*

In the above table the names of the mines marked by (*a*) are copper mines from which the gold has been obtained as a by-product. An asterisk after a certain year indicates that during that year the mine was worked but very little.

Of the above mines, those marked with an (*a*) are copper mines, the ores of which have furnished some gold and more silver as by-products. The mines producing the greatest amount of gold and silver in 1904 are as follows, given in the order of the yield of their production: The Iola, of Montgomery County; the Barringer mine, of Stanly; the Union Copper Company's mine, of Rowan County; the Miami (formerly Phœnix), of Cabarrus; the Fentress, of Guilford; and the Colossus, of Union. The Fentress mine, of Guilford County, was operated a considerable part of 1904, up to the death of the manager. The mine is now being operated by the Guilford Mining Company.

The Miami mine, in Cabarrus County, was worked very vigorously in 1904, and the latest work is on the 425-foot level, where an 8-foot vein has been encountered.

The Barringer mine, in Stanly County, was worked during the early part of 1904, but was flooded on August 11th, and thus far there has been no indication of unwatering the mine and renewing the work.

The Colossus mine, in Union County, has also been worked quite extensively and has treated a considerable tonnage of tailings from previous mining. It has also done some underground development work. The Indian Trail mine, also in Union County, encountered a small but very rich vein, which was worked in a small way during 1904.

In Montgomery County the Iola was worked quite extensively during the year at the 250-foot level, and this is the most profitable mine at the present time in the State.

The Montgomery mine, which is near the Iola, is making arrangements for carrying on a considerable amount of development work, while prospecting is being done on the Golconda property adjoining.

In Mecklenburg County nothing of importance has been accomplished in gold mining during 1904. The re-opening and the development of the Rudisill and St. Catherine mines are proceeding very slowly, and but little has thus far been accomplished with these properties.

In Rutherford County the Wolverine Gold Mining Company are developing a property about 4 miles from Rutherfordton. A shaft has been sunk to the depth of 100 feet, which encountered a narrow vein, which assayed very well, its width averaging about 18 inches. The property acquired by this company is supposed to be the property that was worked a good many years ago by the Rutherford Gold Company, but no data can be obtained regarding the work done by this company. There was an old tunnel discovered on the property by the company, which they followed for a distance of 350 to 400 feet, but on account of the cave-ins, they gave up following it further. It is known in the vicinity as the Bechtler tunnel, but no information could be obtained as to when it was made, or for what purpose. It starts in a southwest direction and then shortly turns abruptly to the west and then again to the northeast. It is approximately 10 feet wide and 8 feet high and cut through the country rock. As far as could be discerned, there is no vein material visible, but the walls of the tunnel were assayed and gave a value of $1.40 per ton in gold. The company have equipped the property with the necessary machinery for carrying on their development work and for taking out ore.

There is an interesting property being developed in Surry County, in the vicinity of Elkin, on the property of Mr. R. N. Chatham. The vein can be traced for 500 or 600 feet and is prominently exposed in two stream-beds and outcrops at various places in this distance. Its trend is N. 55° E. It has been tested at a number of points and cross-cuts have been made at several places. Assays made of average samples of this ore gave $15.80 and $18.40 per ton. The location of this vein and the quality of the ore make this a very promising property for further development.

In Catawba County, at the Shuford mine, a large amount of work was done and the mining has been carried to the 60-foot level. In treating the ore no stamp-mills are used, but a centrifugal disintegrator from which the ore is fed to sluice-boxes, where the gold is collected.

In Halifax County, near Essex, the Farley dredge was operated a short time, making a small production of gold during the latter part of the year.

Most of the placer mining was in Burke, Cherokee, Clay, Cleveland, Halifax, Iredell, Lincoln, Macon, McDowell, and Warren counties, the production in all cases being small. In a number of them, as Burke, Cleveland, Iredell and Lincoln, which are counties producing a large amount of monazite, the gold was obtained as a by-product in the mining of monazite. In the following table is shown the sources of the production of gold and silver in North Carolina during 1904:

SOURCES OF THE GOLD PRODUCED IN NORTH CAROLINA DURING 1904.

PROCESS.	GOLD.	SILVER.	TOTALS.
Chlorination works	$ 1,162.83	$..............	$ 1,162.83
Cyanide works	7,273.84	151.68	7,425.52
Dredging	456.32	.84	457.16
Copper ore shipments	13,007.10	17,516.90	30,524.00
Placers	10,429.30	166.11	10,595.41
Stamp mills	90,116.53	1,246.20	91,362.73
Untraceable sources	1,478.08	50.85	1,528.93
Totals	$ 123,924.00	$ 19,132.58	$ 143,056.58

PRODUCTION.

The total coining value of the production of gold and silver in 1904 was $143,057, which is an increase of $12,547 as compared with that of 1903, which was valued at $130,510. Of this production $123,924 was due to the value of the gold produced, an increase of $10,320 as compared with $113,604, the value of the 1903 production. The value of the silver produced was $19,133 (coining value), as compared with $16,907 in 1903, an increase of $2,226. The production of gold and silver of 1904 was divided among 34 counties as compared with 31 counties in 1903, the new producing counties being Alamance, Anson and Chatham. The county producing the largest amount of gold was Montgomery, with a production valued at $50,461, while the smallest productions were from Orange and Alamance Counties, each producing gold to the value of $23.26. The county which was second in the value of its production of gold in 1904 was Stanly, with a value of $17,114, while Cabarrus was third, with a value of $14,890. Montgomery and Stanly were the first and second producers respectively of gold in 1903, while Mecklenburg was third. The production of silver was obtained chiefly from Rowan County, with considerably smaller amounts from Person and Granville Counties, these three representing copper mines which produced the silver as a by-product. Rowan County, which produced by far the larger amount of copper ore, was also the largest producer of silver. In the table below there is given the production of gold and silver (coining value) in North Carolina during 1903 and 1904, by counties:

PRODUCTION OF GOLD AND SILVER IN 1903 AND 1904 BY COUNTIES.*

COUNTY.	1903			1904		
	GOLD†	SILVER†	TOTAL†	GOLD†	SILVER†	TOTAL†
Alamance	$----------	$--------	$----------	$ 23.26	$ .27	$ 23.53
Anson	----------	---------	----------	52.56	1.32	53.88
Burke	1,606.44	17.09	1,623.53	1,507.03	23.03	1,530.06
Cabarrus	3,237.23	85.93	3,323.16	14,889.80	193.08	15,082.88
Caldwell	41.10	.87	41.97	46.52	.41	46.93
Catawba	1,181.07	19.09	1,200.16	5,438.29	105.75	5,544.04
Chatham	----------	---------	----------	96.74	1.60	98.34
Cherokee	1,144.52	5.91	1,150.43	123.76	.74	124.50
Clay	46.51	.29	46.80	57.90	.36	58.26
Cleveland	5,269.40	1.16	5,270.56	180.47	4.46	184.93
Davidson	230.12	161.52	391.64	1,102.77	590.91	1,693.68
Franklin	162.79	2.48	165.27	88.37	1.86	90.23
Gaston	196.84	2.85	199.69	217.88	4.71	222.59
Granville	562.68	2,258.97	2,821.65	610.07	1,189.05	1,799.12
Guilford	3,806.62	159.16	3,965.78	12,853.11	46.16	12,899.27
Halifax	423.81	2.63	426.44	178.54	1.45	179.99
Henderson	186.05	2.33	188.38	32.31	.37	32.68
Iredell	133.84	1.60	135.44	162.20	2.51	164.71
Lincoln	522.42	9.90	532.32	35.03	.84	35.87
Macon	93.02	.58	93.60	46.52	.30	46.82
McDowell	2,260.15	30.60	2,290.75	602.78	14.10	616.88
Mecklenburg	8,578.72	102.89	8,681.61	1,157.99	25.04	1,183.03
Montgomery	48,634.83	878.27	49,513.10	50,460.88	901.46	51,362.34
Moore	388.87	8.04	396.91	310.46	7.04	317.50
Nash	139.54	2.15	141.69	44.18	.95	45.13
Orange	351.46	5.11	356.57	23.26	.15	23.41
Person	1,096.15	8,632.24	9,728.39	171.50	2,734.51	2,906.01
Polk	602.21	4.22	606.43	192.78	1.86	194.64
Randolph	396.30	6.96	403.26	397.62	12.99	410.61
Rowan	1,852.39	4,119.21	5,971.60	4,163.72	12,852.09	17,015.81
Rutherford	1,322.20	16.91	1,339.01	484.95	3.24	488.19
Stanly	24,524.30	116.05	24,640.35	17,113.65	157.32	17,270.97
Union	3,101.84	95.68	3,197.52	9,677.08	224.56	9,901.64
Warren	139.54	1.75	141.29	359.07	2.36	361.43
Unknown	1,370.59	154.22	1,524.81	1,020.95	25.73	1,046.68
Total	113,603.55	16,906.66	130,510.11	123,924.00	19,132.58	143,056.58

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*The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

†Coining value.

As is seen from the above table, all the counties producing gold in 1903 were also producers in 1904, and in addition were the three counties, Alamance, Anson and Chatham.

The next table following shows the value of the production of gold and silver in North Carolina since 1882.

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1904.*

YEAR.	GOLD.	SILVER.	TOTAL.
1882	$ 190,000	$ 25,000	$ 215,000
1883	167,000	3,000	170,000
1884	157,000	3,500	160,500
1885	152,000	3,000	155,000
1886	175,000	3,000	178,000
1887	225,000	5,000	230,000
1888	136,000	3,500	139,500
1889	145,000	3,878	148,878
1890	118,500	7,757	126,257
1891	95,000	6,465	101,465
1892	78,560	12,671	91,231
1893	53,600	17,325	70,925
1894	46,594	455	47,049
1895	54,200	520	54,720
1896	44,300	646	44,946
1897	34,600	388	34,988
1898	84,000	905	84,905
1899	34,500	388	34,888
1900	44,653	15,986	60,639
1901	60,410	34,023	94,433
1902	93,650	30,212	123,862
1903	113,604	16,907	130,511
1904	123,924	19,133	143,057

*Coining value.

COPPER.

Copper mining in North Carolina has not yet become a very important industry, although there are now a number of properties tha are being vigorously developed, but which have not yet become producers of copper. With the closing down of the Holloway mine i Person County, which was the largest producer in the State, ther was a large falling off in the production of copper ore. This mine however, has recently been purchased by Philadelphia parties, wh are contemplating re-opening it or developing ore bodies that ar supposed to exist along the strike of the Holloway vein. The Yance mine, belonging to the Person Consolidated Copper and Gold Mine Company, was not worked to any great extent during 1904, and onl a few car-loads of concentrates were shipped. Thus the productio of copper ore from Person County has been very much reduced Many of the copper properties were not worked at all during 190 while others were developed to a slight extent, and at still other work was carried on vigorously and in some instances plants wer erected for the mining and treating of the ore.

The Hercules Gold and Copper Company, at Cid, N. C., spent a large part of the year in sinking and drifting on their ores, and have a large body of ore now blocked out and ready for stoping. They have erected a complete concentrating plant, which is now in operation, and during 1905 this property should produce a considerable quantity of ore.

The Union Copper Mining Company's mines at Gold Hill, Rowan County, were the largest producers in 1904, but, compared to their plant and their ore bodies, their production was very small. None of the ore was smelted at the company's plant, but was shipped to the Ducktown smelter of the Tennessee Copper Company.

There are a number of other copper properties that were being developed in various sections of North Carolina during 1904, including those of the North Carolina Mining and Milling Company, in Stanly and Cabarrus Counties, the Carolina Copper Company, in Jackson County, and the Whitney Company, in Rowan County. The Ore Knob Copper mine, of Ashe County, which was equipped with a Garretson furnace three years ago and which was blown in and operated for a few days, is again to be opened up in the near future. The method of reduction of these ores is by pyritic smelting.

PRODUCTION.

In 1904 the total production of copper amounted to 4,250 tons of ore, which gave 305,000 pounds of copper, valued at $36,600, or 12 cents per pound. This was obtained from Person and Rowan counties. As compared with the production of 438,133 pounds, valued at $67,037, this is a decrease of 133,133 pounds in quantity and of $30,437 in value. In the following table is given the production of copper in North Carolina in 1900 to 1904:

PRODUCTION OF COPPER FROM 1900 TO 1904.

YEAR.	CRUDE ORE MINED.	COPPER PRODUCED.	VALUE.
	Tons.	*Pounds.*	
1900	6,948	....	$ 41,600
1901	10,398	512,666	76,900
1902	16,741	1,417,020	212,553
1903	4,106	458,133	67,037
1904	4,250	305,000	36,600

IRON.

Although there are numerous deposits of iron ore in North Carolina which contain good ore in quantity, there are but few of these that are being operated. There are several reasons why the other deposits are not being operated: as their distance from sources of fuel and flux, or their distance from railroad transportation. Thus, the ore deposits near Wilson's Mills, Jackson County, and Ore Hill, Chatham County, were obliged to cease operations with the closing down of the Greensboro iron furnace. The large deposits of iron ore at the Ballew mine, in Ashe County, are a long distance from fuel and also from railroad transportation. This deposit is a magnetic iron ore and occurs in large quantity, and if it should be connected with the coal-fields of West Virginia by railroad facilities, this deposit would undoubtedly be worked very extensively.

During 1904 the only mines that were operated were the celebrated Cranberry mines, at Cranberry, Mitchell County, which contains magnetic iron ore and furnishes a pig-iron of superior quality. This mine is the most famous and noted one in the State and has been the only constant producer of iron ore. The other property that was worked was a deposit of brown hematite iron ore near Andrews, Cherokee County.

PRODUCTION.

The total production of iron ore in North Carolina during 1904 amounted to 64,347 long tons, valued at $79,846, and was obtained from Mitchell and Cherokee Counties. As compared with the production of 82,851 tons, valued at $78,540, the 1904 production is a decrease of 18,534 tons in quantity, but an increase of $1,306 in value.

CHROMITE.

Although there was no chromite ore produced in North Carolina during 1904, yet on account of the constant demand for this mineral in the United States, which is supplied almost entirely by imported ores, and on account of the construction of railroads which now pass very close to extensive chromite deposits, this mineral is treated somewhat briefly in this report.

Chromite is an iron-black to brownish-black mineral in color, having a sub-metallic luster. Its hardness is 5.5. Its chemical composition is usually represented by the formula $FeCr_2O_4$ where a part of the iron is replaced by magnesia and the chromium by aluminum and ferric iron. It is found in small amounts in a great many places throughout North Carolina as an associated mineral in peridotite formations, where it occurs in grains and crystals and frequently in imbedded masses near the contact of this rock with the gneiss or other country rock. It is usually massive and from fine granular to compact, but occasionally it is found in small, but perfect, octahedral crystals. At a number of localities in the western part of the State it has been found in considerable quantity, and with proper railroad facilities some of these deposits should be capable of being worked profitably and become sources of supply of chromite. One of the more promising localities is in Yancey County at Mine Hill on the Mine Fork of Jack Creek, 5 miles north of Burnsville, the county-seat, on the Bakersville Road, where a large peridotite (dunite) formation outcrops on both sides of the road. Seams or pockets of chromite ore are abundant in this peridotite, varying from 0.5 inch to 3 inches in thickness. Near the summit of the hill, on the east side of the road, about 150 feet above the road and stream-bed, a deposit of chromite has been opened from which 25 tons of ore were taken, a large part of which still remains on the dumps. A pit 9 feet deep was sunk on the deposit; but this has been filled with water since the work ceased, so that no estimate can be made of the extent of the deposit. Mr. Garrett Ray, of Burnsville, N. C., the owner, reports that the chromite widened to between 2 and 3 feet at the bottom of the pit. There are other promising seams or veins, which appear to indicate the existence of a deposit of chromite ore near the contact of the peridotite and gneiss.

On the west side of the road the peridotite formation rises in another hill, and here there are numerous small seams and pockets of chromite. On the extreme western slope of the formation a trench has been cut 100 feet or more into the hill, in which are exposed many small pockets of chromite. The work done in this trench is of a prehistoric character, and whether the object of the exploration was chromite or not has never been explained.

With the exception of the pit sunk near the summit of Mine Hill, from which a few tons of ore were shipped, no mining has been done here, and very little prospecting has been undertaken to determine the exact extent of the chromite deposits. The distance from the railroad has greatly discouraged systematic prospecting in this region. The shipping point at the time this work was done was Asheville, on the Southern Railway, about 40 miles to the south. The railroad from Erwin, Tenn., to Marion, N. C., which is now partially completed, passes within 3 or 4 miles of this locality.

An analysis of a selected specimen of the chromite (Baskerville, analyst) gave the following results:

ANALYSIS OF SELECTED SPECIMEN OF CHROMITE FROM MINE HILL, FIVE MILES NORTH OF BURNSVILLE, YANCEY COUNTY.

	Per Cent.		Per Cent.
Cr_2O_3	58.00	MgO	8.26
Al_2O_3	15.52	SiO_2	3.20
FeO	14.45	CaO	.70

Although this analysis represents a selected sample of the chromite, yet from the character of the material it is not unreasonable to expect an ore that, by hand-picking and cobbing, will assay in the neighborhood of 52 per cent. of chromic oxide, with a low percentage of silica.

About 9 miles west of Burnsville, near Price Creek, there is a narrow bed of peridotite on the land of Mr. W. A. Robertson, a quarter of a mile from Price Creek post-office. A pocket of chromite discovered here yielded nearly 7 tons of ore. This exhausted the pocket, and since then no prospecting has been done in this vicinity.

An analysis of a selected sample of this ore (Baskerville, analyst) gave the following results:

ANALYSIS OF SELECTED SAMPLE OF CHROMITE FROM PRICE CREEK, NINE MILES WEST OF BURNSVILLE, YANCEY COUNTY.

	Per Cent.		Per Cent.
Cr_2O_3	59.20	MgO	4.42
Al_2O_3	7.15	SiO_2	3.20
FeO	25.02	MnO	.92

In Jackson County, in the vicinity of Webster, there is a large peridotite (dunite) formation extending for about half a mile north of the town to a mile and a quarter south. The widest part of the area, about a half a mile, is at Webster, the town being partly built on a dunite hill. The Tuckaseegee River cuts through this formation about a half a mile below the town. Considerable prospecting has been carried on in this region, and numerous veins and pockets of chromite of varying extent have been discovered.

The only deposit of any note found on the north or Webster side of the river is on the east side of the Tuckaseegee Road, about 200 yards from the main street of the town, on the land of Daniel Schneider. A pocket of chromite was uncovered here which yielded a number of tons of chromite, most of which was shipped. At a depth of nearly 9 feet the pocket pinched out, leaving but a small seam of chromite in sight. Many small seams and pockets of chromite are to be seen, but no other work has been undertaken for chromite on this side of the river.

On the south side of the river, following closely the contact of the dunite with the gneiss, a line of prospect pits have been dug which show the presence of a considerable amount of chromite. The prospecting has been done on the land of Joseph Hooker, Lawrence Buress, Alf Wilson, James Ashe and Daniel Fullbright, all of Webster, N. C. The most promising deposits are one on the land of James Ashe, where a cut 25 feet long, 6 to 8 feet wide and 8 to 10 feet deep was sunk on a vein of chromite 12 to 18 inches thick, which at the bottom of the cut is 12 inches thick; and another on the land of Daniel Fullbright, where a seam nearly 12 inches thick is exposed in the branch. The nearest shipping point is Sylva, on the Southern Railway, 3 miles north of Webster.

Chromite has been found at a number of places in the masses of peridotite within two or three miles southwest of Balsam Gap, Jackson County. The most promising outlook for a large deposit is on Dark Ridge Creek, about 525 feet south of the Dark Ridge trestle of the Murphy Branch of the Southern Railway. On the east side of the creek a cut 18 feet deep and 10 feet wide was made on a pocket of chromite, from the bottom of which two seams of chromite, 6 and 8 inches thick, respectively, extended. Fifteen tons of ore were taken out of the main pocket. About 200 yards farther south, on the opposite side of the creek, a shallow pit was sunk which encountered considerable chromite. Both these openings were near the contact of the peridotite and gneiss. Between these and in their near vicinity there is a large quantity of float ore. These facts point to this locality as one worthy of further development, with an expectation of finding a large quantity of ore. Its proximity to the railroad is also a great advantage. Analyses show the ore to carry about 49 per cent. of

Cr_2O_3. The property is owned by the Highland Forest Company, of Waynesville, N. C.

No large deposits of chromite have yet been found in North Carolina, but the work done shows that extensive deposits may exist in the State, those described above being the most promising ones known.

The standard chrome ore contains 50 per cent. of Cr_2O_3, and the value of the ore increases with each unit over this. Ores as low as 45 per cent. of Cr_2O_3 find a ready market, if they are low in silica. The North Carolina ores are of high grade and are usually low in silica.

The largest use of chromite is in the manufacture of ferro-chromium alloys and the metal chromium, which is used in the manufacture of chrome steel. This in turn is used in the manufacture of armor-plate used in combination with nickel. The manufacture of the ferro-chromium alloys can be accomplished in the electric furnace, crucible furnace, or blast furnace, but at the present time it is made most extensively in the electric furnace. Formerly, however, before the converting of our water-powers into electric power, the principal method of making ferro-chrome was in blast furnaces. By this process, however, only a low-grade ferro-chrome alloy could be obtained, the chromium content being from 30 to 40 per cent. With, however, the introduction of the electric furnace for the manufacture of these alloys, the chromium content has been increased to 60 per cent. and upwards, and at the present time the alloys that seem to be in the greatest demand are those containing from 60 per cent. or more of chromium. The main objection to the use of crucible furnaces is that only small quantities of the ferro-chrome alloy can be prepared at one time, but the chromium content is very high. Ferro-chrome alloys are now being prepared in large quantity by means of the electric furnace in the United States, in France, and in Germany. Where formerly these ferro-alloys were apt to contain a rather high percentage of carbon, the processes have now been so improved and regulated that ferro-chrome alloys can now be made in the electric furnace that contain but a fraction of a per cent. of carbon, and the product of the furnace can now be made approximately uniform.

Some of the principal firms manufacturing ferro-chrome alloys are the Wilson Aluminum Company, at Kanawha Falls, West Virginia and Holcomb Rock, Virginia; Chrome Steel Works, Brooklyn, New York; the Hecla Works, Sheffield, England; Geo. G. Blackwell Sons & Co., Liverpool, England; and Hugo Krupp, Hanover, Germany. In

France there are a number of plants manufacturing ferro-chrome, as follows: *Societé Electrometallurgique Française at La Praz, Societé La Néo-Métallurgie at Giffre, Societé Anonyme Electrometallurgique at Albertville; Keller, Leleux & Co., at Livet; Societé Electrometallurgique de Saint-Béron at Saint-Béron, Ch. Betrolus at Bellegarde, and Rochette Frères at Epierre.

TIN.

Although there was no shipment of tin ore in North Carolina during 1904, there was considerable development work carried on by the Carolina Tin Company, at the Jones mine, in Gaston County, about 7 miles north of Kings Mountain. During this work two shafts 200 feet apart were sunk on the vein, one to a depth of 100 feet and the other 41 feet. This work has shown the vein to be continuous to these depths, and from these shafts 300 feet of drifts have been run at different levels. From the 150-foot shaft a 23-foot vein was cut on the west side of the shaft whose trend is northeast and southwest and pitching toward the west. A new shaft has been started at a point so that it will cut the vein at a depth of 300 feet. This vein, which was followed from the 150-foot shaft, widened from where first encountered to 27½ feet.

Other properties that are being worked are the Beaver Dam property, about 11 miles northeast of Kings Mountain, and the Parker place, which is within the corporate limits of Kings Mountain. This latter property has been worked to a depth of 25 feet.

A detailed description of the Tin Deposits of the Carolinas has recently been published as Bulletin No. 19 of the North Carolina Geological Survey.

ABRASIVE MATERIALS.

The abrasive materials that were mined in North Carolina during 1904 included millstones, garnet and corundum, given in the order of the importance of their productions. This industry in the State is not large and, since the closing down of the corundum mines at Cullasaja, Macon County, and the garnet mines at Sugar Loaf Mountain, Jackson County, the value of the production of abrasives has been very small.

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*Electrochemical Industry, Vol. II, 1904, p. 450.

The most noticeable change of the abrasive industry during the past year has been the production of garnet from a locality near Marshall, Madison County, which was described in the report for 1903. The only corundum property that was operated during 1904 was the Herbert mine, owned by the North Carolina Corundum Company and located at Buck Creek, Clay County. The millstones were all obtained from near Faith, Rowan County.

PRODUCTION.

The total production of garnet and corundum in 1904 amounted to 202 tons, valued at $6,586, which is a decrease of 201 tons in quantity and of $7,664 in value as compared with the production of 403 tons, valued at $12,250, in 1903. There were 208 pairs of millstones, valued at $6,500, produced in 1904, as compared with 63 pairs, valued at $902, produced in 1903. This makes the total value of all the abrasive materials produced in 1904 $13,086, as compared with $13,152, the value of the 1903 production. The production of these abrasive materials for 1901 to 1904 are given in the following table:

PRODUCTION OF ABRASIVE MATERIALS 1901-1904.

YEAR.	CORUNDUM.		GARNET.		MILLSTONES.		TOTAL VALUE.
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	
	Tons.		*Tons.*		*Pairs.*		
1901	325	$48, 840	775	$43, 000	----	$------	$91, 840
1902	----	-------	260	10, 040	50	1, 425	11, 465
1903	----	-------	403	12, 250	63	902	13, 152
1904	----	-------	202	6, 586	208	6, 500	13, 086

MICA.

INTRODUCTION.

North Carolina still continues to be the chief mica-producing State of the United States, and its mica is the standard mica by which all the others are graded. Although this mineral occurs widely distributed throughout the United States and has been found in commercial sizes in about one-third of the States and Territories, it is only in a few that it is a mining industry. During 1904, mica was mined in California, Colorado, Connecticut, Georgia, Idaho, North Carolina, New Hampshire, New Mexico and South Dakota, nearly ten-elevenths of the total value of this mica produced in the United States having been obtained from North Carolina. Besides the domestic production of mica, there is a considerable quantity imported each year, which is obtained principally from Canada and India.

COMMERCIAL VARIETIES OF MICA.

There are a number of minerals that belong to the mica group, only a few, however, being of commercial value, namely, muscovite, phlogopite, and lepidolite. The last of these three minerals is only mined for its lithia content, and is not used for any of the purposes of a commercial mica. The other two micas—muscovite and phlogopite—include all the commercial mica that is on the market. In North Carolina it is only the muscovite that is mined, as there are at the present time no known commercial deposits of phlogopite in this country. In Canada and India, on the other hand, the chief mica deposits are of the phlogopite variety, with smaller deposits of muscovite.

Muscovite mica is chemically a hydrous potassium aluminum silicate, and is classified as potash mica. It is usually transparent and colorless, constituting most of the white mica on the market. Occasionally it is of a rum to ruby color. Frequently there are other minerals inclosed by the mica, sometimes crystallizing in finely-divided films between the foliæ of the mica, as magnetite, flattened garnet, quartz, and tourmaline crystals, and these sometimes ruin the blocks of mica completely as a source of sheet mica.

Phlogopite mica, which is also known as magnesia mica, is a hydrous magnesium aluminum silicate, containing also some potash and soda. It is usually of a rather even color, which varies from a yellowish brown to brownish red with often something of a copper-light reflection. Occasionally it assumes a nearly black color. A considerable part of the amber mica on the market is the phlogopite variety, and Canada furnishes the chief supply.

Another mica that is commonly associated with muscovite in many pegmatitic dikes is biotite, an iron magnesia mica similar in composition to the phlogopite, but having a large part of the magnesia replaced by iron. It is much darker in color than the phlogopite, being nearly black, and does not occur in as large crystals.

The commercial value of muscovite and phlogopite is due to the very high development of the basal cleavage which permits of the splitting up of the crystals and blocks of mica into sheets of one-thirty-second or one-sixteenth of an inch in thickness as used commercially, but the cleavage can be continued perfectly up to at least one one-thousandth of an inch.

OCCURRENCE.

The muscovite represents the most common mica and is very widely distributed, being a component of many of the crystalline and sedimentary rocks. In many of these it occurs in but small scales or crystals which have no commercial value. When, however, it occurs in blocks or masses which can be split into sheets an inch or more in diameter, it has a commercial value which increases with the size of the cut sheets, and these vary from 1 by 1 to 8 by 10 inches. These commercial deposits of mica are found for the most part in pegmatitic dikes or veins, which occur as intrusives in granite and in hornblende and mica gneisses and schists. These dikes or veins vary in thickness from a few inches to several hundred feet and are often very irregular, having arms or apophyses branching off from them and extending out into the country rock in many directions. Sometimes these dikes are parallel to the bedding or schistosity of the gneiss or schist, and then again they break across it at varying angles. Both of these phenomena are often observed in the same dike. In character these pegmatitic dikes are very similar to granite, and occasionally they have been designated as a "coarse granite." The principal mineral constituents of these dikes are quartz, feldspar, and muscovite mica, which occur in varying proportions. In examining these dikes it will be found that sometimes the quartz and feldspar are nearly equally distributed throughout a certain part of the vein, while in other parts sometimes one and again the other will predominate. Feldspar has been observed that has crystallized out in enormous masses of more than a ton in weight, and in one instance, the Irby mine, near Spruce Pine, Mitchell County, N. C., a well-developed crystal of feldspar was observed that measured 3 by 11½ feet. Occasionally feldspar, quartz, and mica have separated out in rather small

North Carolina
State Library.

masses, giving the vein the appearance of containing an equal quantity of each. In such cases the three minerals are so intimately associated with each other that the mica is of little or no commercial value and the feldspar is also of no commercial value. Judging from observations made at a great many mica mines, the pegmatitic dikes that yield the best commercial mica are those in which the three minerals have had a tendency to crystallize out in large masses. Thus, where feldspar and quartz are in small crystals or fragments, the mica is also apt to be small. Those dikes that are two feet or less in width very seldom contain mica having any commercial value beyond what could be obtained for it as scrap mica, and hence little or no attention should be paid to such dikes as a source of mica. Not all of the wide dikes carry mica of the right quality or in sufficient quantity to afford profitable mining, for in some the mica has been observed to occur in such small crystals and blocks that no sheets could be obtained over an inch or two in diameter.

The muscovite mica occurs in these dikes usually in rough crystals (called blocks or books, which are sometimes distributed nearly evenly throughout the dike and at other times nearer the contact of the dike with the country rock. These blocks of mica are occasionally nearly perfect in their crystalline form, which is monoclinic, but imitating rhombic or hexagonal symmetry. The commercial blocks of mica usually vary in thickness from 6 to 18 inches and from 3 to 15 inches in diameter, although some blocks have been found as much as 4 feet in diameter and from 2½ to 3 feet in thickness. All of the large blocks of mica are not of sufficient quality to cut into sheets as large as would be expected from the size of the crystal, on account of much of the mica having been converted into what is called "ruled mica," the mica being divided into narrow strips whose edges are parallel to the intersection of the prism and base edges of the crystal, or into "A" mica, in which the sheets are cut or striated parallel to two adjacent edges.

PERCENTAGE OF MICA IN THE DIKES.

There is considerable variation to be noted in the percentage of mica that occurs in these dikes and in different parts of the same dike. It is usually found, however, that in any considerable distance in the same dike the mica will average for that distance approximately the same per cent. It is seldom that the mica in a dike will average over

10 per cent. of the contents of the dike for any considerable distance, and it will sometimes average as low as 1 per cent. Portions of certain dikes have been observed that had the appearance of containing a very large percentage of mica on account of a number of blocks of mica being clustered together in bunches almost touching one another, while in other portions of the same dike there would be almost a complete absence of mica for a distance of from 5 to 20 feet; but even in such a dike the general average of the mica to the other minerals corresponded to about 10 per cent. The general limits of the percentage of mica in various dikes is probably, therefore, from 1 to 10 per cent.

Of the mica that is obtained in these dikes, there is probably an average of not over 10 to 15 per cent. that can be cut into sheet mica, the rest being waste or scrap mica. Selected masses or blocks of mica, however, have been mined that have averaged from 30 to 40 per cent. and occasionally as high as 75 per cent. of sheet or plate mica. On the other hand, there will be certain portions of the dike in which none of the mica mined can be cut into sheets or plates, and is all of value only as scrap mica. These variations have been observed where they have taken place within the space of a few feet. As far as can be ascertained from observations in the field and from the results of mining, the North Carolina mines will average the highest percentage of cut mica of any in the United States.

There are a number of reasons for this large percentage of waste mica—the irregularity of the blocks of mica and of the individual sheets; the ruled mica and the "A" mica, which reduce the sizes of sheets that can be cut or prevent entirely any sheets being cut from the block; the mica may be specked or stained, or may contain a great deal of magnetite in thin crystallized films between the foliæ of the mica; and many blocks of mica may be destroyed by having garnet, tourmaline, or quartz crystallized out between the foliæ. It will be observed from what has been said that in mining mica there must necessarily be a very large amount of waste rock or gangue removed, and, as in nearly all mica mining it is necessary to operate by blasting, it makes the cost of production of the crude mica somewhat expensive. Hence, if any of the other minerals that must be removed in mining can be utilized commercially, they will make valuable by-products and will help to pay the cost of mining the mica. There are certain minerals associated with the muscovite mica in these veins that are of commercial value and that are discussed later under Associated Minerals.

METHODS OF MINING.

The mining of mica in North Carolina has been carried on largely in a desultory manner and by individuals who had little or no capital which would enable them to mine systematically or continuously on a vein when the mica in the vein became poor. A great deal of the mining has been done by open cuts and pits and shallow shafts which, as soon as they reach water-level, were abandoned; by low tunnels which have followed in on the veins where good mica had been exposed on the surface or was very quickly encountered as the tunnel was extended. These tunnels were always small and often zigzag and without any definite direction or size, and have led to the term "ground-hogging" as applied to considerable of the mining in North Carolina. Other mica deposits have been opened up by inclined shafts, with drifts running from them on the vein at various levels and the vein material in between the levels partially stoped out. In other cases sections of the vein have been mined from the surface downward, the walls being supported by large timbers. There are but very few of the mines that have been equipped with steam plants for hoisting the mica and waste, and nearly all this has been done by hand or horse windlass. By mining the mica deposits by means of a compartment working shaft, from which drifts are extended at regular intervals and stoping out the vein material between these levels, it would only be necessary to raise to the surface the mica, leaving all the waste material to fill up the stopes. In many instances the dip of the veins is not far from the vertical, so that the shaft will be in the vein for a good many feet. Usually the walls are firm, so that there is but little timbering necessary in the drifts and stopes.

On account of the irregularity of the occurrence of the blocks or books of mica in the vein, nothing is known of their position by the miner unless he has exposed one or more by previous blasting, and it often happens that in drilling the drill will pass right through one of these blocks of mica, often ruining some very large sheets. Though this may sometimes become apparent by the material that is taken out of the drill hole, still the miner would be unable to determine whether his drill was in contact with a good block of mica or merely with small masses, and so the only thing for him to do is to keep on with the hole he is drilling and to let the blasting reveal what kind of a block of mica he has drilled into. The percentage, however, of blocks of mica that are spoiled by drilling is very small. Occasionally, after blasting, the miner will find exposed in the face of his drift a half dozen or more blocks of mica, some with the face of the block exposed and others with just their edges showing. He is then able either to gad out these blocks or, by means of pop holes, to remove all of the blocks without injuring them. It is customary in many of the mica mines to blast out the mica and gangue by means of benches, which perhaps eliminates, as far as possible, the chances of ruining the good blocks of mica.

ASSOCIATED MINERALS.

As has already been stated, the three principal minerals of these pegmatitic dikes are quartz, feldspar and muscovite mica, and these probably constitute about 95 to 99 per cent. of the dike. Besides these, there are a large number that occur in these pegmatitic dikes, sometimes sparingly and at other times abundantly. A list of these minerals was given in the report for 1901. *The majority of these minerals are found very rarely in pegmatitic dikes and some have been found at only one locality. Others are found frequently throughout many of the pegmatitic dikes, although some dikes have been observed that contained no other minerals besides feldspar, quartz and mica. Of these associated minerals, the common accessory minerals are beryl, some one of the garnets, tourmaline and apatite. Magnetite is a mineral very commonly associated with the mica in these pegmatitic dikes, and occurs as small films of mineral crystallizing out between the foliæ of the mica. In certain localities, as at the Wiseman and Flat Rock mines, Mitchell County, the uranium minerals, uraninite, gummite, etc., are quite common; also the tantalum minerals, columbite, and samarskite are found in a number of the pegmatitic dikes of Mitchell and Yancey Counties. These latter are described beyond on pages 46-53. A number of these accessory minerals are the gem minerals, some of which have been found in commercial quantity, as the different beryl gems, garnet, hiddenite, rutile, etc.

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*Economic Paper No. 6, 1901, p. 42.

Where any of these associated minerals can be utilized commercially, they make valuable by-products. The most promising ones in North Carolina are quartz and feldspar, which could be used for pottery purposes; beryls for gems; columbite as a source of tantalum; and uraninite or pitchblende and gummite for their radium contents.

LOCALITIES.

The principal deposits of mica in North Carolina are in Ashe, Mitchell, Yancey, Jackson, Haywood, Macon, Transylvania, Cleveland, Lincoln, Caldwell, Watauga and Stokes counties. The principal mines that have been worked are the Clarissa, Sink Hole, Hawk, Doublehead, Spread Eagle, Deake, Gibbs, Aley, Young and Cloudland mines, in Mitchell County; the Ray, Presnell, Little Zeph, Roberson, Sleepy Hollow, Tolly Bend and Young mines, in Yancey County; the Big Ridge and Sherry, in Haywood County; the Iola, Burningtown and Rabe, in Macon County; the Empire and Hawkins mines, in Stokes County; the Grimshawe mine, in Transylvania County; the Beaver Creek mine, in Caldwell County; Stony Fork mine, Watauga County; the Laytown, Royster and Stemley mines, Cleveland County; and the Gault and Houser mines, Lincoln County.

More or less development work and mining was carried on at nearly all of these properties during 1904, although at many of them there was no production of mica, this being true of the mines east of the Blue Ridge.

With few exceptions, the mica deposits at the above localities are worked by individuals and generally on a very small scale, so that there are a large number of small producers of mica in North Carolina who have worked their deposits for a few days to a few months during the year and obtained mica valued at from $10 to $500 as a yearly production. There are, however, a few large companies who are carrying on systematic mining, sinking their shafts below water-level and having their mines equipped with steam hoisting and pumping plants. Some of these shafts are down between 400 and 500 feet. The principal companies operating are the Burleson Mica Company, in Mitchell and Yancey counties; the Sylva Mining Company, mining principally in Haywood and Jackson and Macon counties; and the Laytown Mica Company, in Caldwell County. Although the Ashe County localities were not in operation during 1904, there are a number of favorable localities for mica mining which give promise of containing a good quality of mica in commercial quantity.

The mines of Watauga County, in the vicinity of Stony Fork, were worked for about two months during 1904, principally by Arthur Welsh, of Stony Fork, without, however, any production of mica.

USES.

Twenty-five years ago, almost the only use for mica was for cutting into sheets of varying sizes to be used for stoves, and the very small pieces of scraps obtained from cutting the plates or sheets, together with the waste obtained in mining, were thrown away as valueless. Now, however, there is a very large demand for mica for electrical purposes, and this has resulted in the utilization of a great quantity of the small pieces of mica that were first thrown away and were then used as scrap mica, which was ground. These pieces are now cut by machinery into small circular disks (1 inch in diameter) and rectangular pieces (3/4 by 2 inches), which are used for insulation purposes in electrical apparatus. Larger sheets of mica are also used for electrical purposes, but it has been found that a large sheet can be built up from small ones, which will give as satisfactory results as the single large sheet, and are, of course, not so expensive. The use of the sheets of clear, white mica for stoves has decreased very rapidly during the last ten years, and there is not now the demand for as many of the larger sheets as there was formerly, although the decrease in the demand for use in stoves has been somewhat balanced by the demand for the sheets for the manufacture of chimneys for incandescent lights and for use in the manufacture of many novelties.

The large percentage of scrap mica, which constitutes from 75 to 90 per cent. of the mica mined, and which was formerly all thrown away, is now utilized principally in the form of ground mica. This ground mica, which is separated into different sizes and grades, is now being utilized for a great variety of purposes. The coarser grades are used in the manufacture of fire-proof materials, principally paint, and for the packing of steam-pipes, boilers, etc., to prevent radiation of heat, as mica is a very good non-conductor. In the manufacture of lubricating materials, the mica must be ground to a still finer degree; and the very finest product is used in the manufacture of certain kinds of wall papers, for other decorative purposes, and in the manufacture of paints.

PRODUCTION.

The production of plate or sheet mica during 1904 was 610,121 pounds, valued at $100,724, this being an increase of 225,121 pounds in quantity and of $14,424 in value, as compared with the production of 385,000 pounds, valued at $86,300, in 1903. This large increase in the quantity of mica produced as compared with the increase in value is due principally to the larger production of the small disks and rectangular sheets that were used so largely for electrical purposes. The scrap mica produced in 1904 amounted to 341 tons, valued at $3,410, an average of $10 per ton. As compared with the production of 1903 of 300 tons, valued at $2,400, this is an increase of 41 tons in quantity and of $1,010 in value. There is given in the following table the approximate value of the production of sheet mica by counties for the years 1900 to 1904, inclusive:

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900, 1901, 1902, 1903 and 1904, BY COUNTIES.

COUNTY.	1900.	1901.	1902.	1903.	1904.
Ashe	$-------	$-------	$-------	$ 1,000	$-------
Buncombe	---------	---------	250	300	---------
Caldwell	---------	---------	---------	---------	10,000
Haywood	11,000	11,500	20,000	18,000	34,500
Jackson	7,000	8,740	5,700	5,500	924
McDowell	1,000	500	600	1,000	---------
Macon	5,200	---------	4,000	3,500	---------
Mitchell	26,722	33,506	28,203	29,000	21,500
Stokes	1,000	---------	1,000	7,500	---------
Transylvania	500	600	750	500	---------
Yancey	12,788	25,003	21,150	20,000	34,000
Total value	$65,200	$79,849	$81,653	$86,300	$100,724

QUARTZ.

The only direct mining for quartz in North Carolina is for use as a flux in copper smelting, and the entire mining for this mineral has been confined to Cherokee County, the mineral produced having been shipped to the Ducktown copper furnaces at Ducktown, Tenn. The Holloway mine, in Person County, which produced a certain amount of quartz for fluxing purposes in 1903, which was shipped to the smelters at Norfolk, Va., made no shipments of quartz during 1904. This mine and adjoining property has recently been sold to Philadelphia parties, who are developing same and expect to again make this a copper-producing mine.

PRODUCTION.

The total production of quartz during 1904 was 32,972 tons, valued at $36,269, as compared with 29,462 tons, valued at $36,827, the production of 1903. This is an increase of 3,510 tons in quantity, but a decrease of $558 in value. In the table following is given the production of quartz in North Carolina for the years 1901 to 1904, inclusive:

PRODUCTION OF QUARTZ IN NORTH CAROLINA, 1901-1904.

YEAR.	QUANTITY.	VALUE.
	Tons.	
1901	3,000	$ 7,500
1902	4,500	11,250
1903	29,462	36,827
1904	32,972	36,269

BARYTES.

INTRODUCTION.

The mineral barite, or, as it is commercially known, barytes, is beginning to be used more and more each year as a white pigment although there may be very little, if any, that is used alone for this purpose. It is, however, used in large quantities to mix with white lead, zinc white, or a combination of both these white pigments Whereas, formerly, its addition to these other pigments was considered as an adulterant, it is now appreciated that the addition of barytes makes a white pigment more permanent, less likely to be attacked by acids, and freer from discoloration than when white lead is used alone It is also believed that the barytes gives greater body to the paint and makes it more resistant to the influences of the weather. As is well known, pure white lead, when it remains in the shade or in a dark place, becomes discolored, becoming yellowish, while mixtures of white lead and zinc white, or of white lead and barytes, or of white lead, zinc white and barytes, retain their color permanently, even in dark places. At the present time about four-fifths of the total production of barytes is used in the manufacture of white pigments, the bal ance being used in the manufacture of paper and rubber, in the preparation of a material for coating canvas sacks in which hams are wrapped, and in the manufacture of barium compounds, principally the hydroxide.

The barytes that is prepared for market varies considerably in its composition, the principal impurities being silica and lime, as well as traces of iron oxide and of manganese dioxide. These impurities are highly undesirable where the barytes is to be used as a pigment. Although these variations in the quality of the barytes are known and appreciated by those who grind the mineral and prepare it for market, the purchasers of this material for pigments or other purposes are not familiar with these variations and have usually paid little or no attention to testing the product. The barytes should be tested chemically in order to determine its percentage of silica, which would represent the grit contained; also its percentage of lime, iron and manganese. In a first-grade barytes there should be no calcium carbonate, silica, free iron oxide, or free manganese dioxide. It would be well to note not only the color of the dry powder, as compared with some standard sample, but also the color after it has been rubbed down in refined linseed oil. Occasionally, samples of barytes will be found that on grinding with oil assume a grayish or even a reddish shade. Another point to be considered is the quantity of oil required to grind the barytes to a paste. In general, the inferior grades of barytes require more oil for this purpose.

CLEANING AND PREPARING BARYTES FOR MARKET.

During the mining and in the first stages of cleaning the barytes many of the minerals which occur with barytes can be eliminated. The commonly associated minerals of barytes in the large deposits are galena, quartz, calcite (calcium carbonate), limonite (hydrated ferric oxide), either massive or as thin stains on the barytes, and manganese dioxide. In sorting the lump ore as it is mined, that showing streaks of quartz should be eliminated from the first-grade ore. The iron-stained barytes can sometimes be so cobbed that only a small amount of the stained lumps go into the first-grade material. It is the occurrence of these iron stains that necessitates the bleaching of the greater portion of the barytes that is mined. Much of that mined in Germany is ground and prepared for market without any bleaching, and this is also true of some of the barytes produced in this country. The bleaching process, while not an elaborate one, adds considerably to the cost of production of the first grade of barytes. Where the ore contains considerable galena, in rather large masses, the bulk of it can usually be removed during the process of hand-cobbing the ore; if it occurs as small particles scattered through the barytes, it can usually be almost entirely removed by jigging after the ore has been crushed to one-fourth or one-half mesh. The iron minerals that occur in the barytes may sometimes also be entirely removed in this same manner.

When the barytes has been cleaned as far as practicable by hand-cobbing at the mines and divided into 1, 2, 3, or 4 grades, it is shipped to the mills, where it is further cleaned by crushing and washing or jigging to remove as many impurities as possible. The next process in preparing the barytes for market is known as bleaching* The ore is crushed to a size varying from that of a pea to half an inch, according to the extent of iron oxide that it may contain and whether this oxide is in the form of scales or as a stain. If as the former, it can often be removed, as stated above, by jigging.

In bleaching the barytes, the crushed mineral is placed in wooden tanks lined with sheet lead and holding from 5 to 25 tons of mineral. The tanks used are either circular or rectangular, the former being preferable for the reason that the steaming can be more uniformly done. The best size is 4½ feet high and 8 feet in diameter. With a tank of this size, one steam inlet is required. The most satisfactory tanks are made of stout, well-seasoned cypress wood, which are well braced on the outside and lined on the inside with heavy sheet lead. A lead coil of pipe ½ to 2 inches in diameter is constructed in such a manner that either steam or water can be supplied through the perforations which are best located at an angle of about 45° to the vertical diameter of the pipe rather than directly on top of the pipe. With the perforations in this position, there is less chance of the holes becoming clogged up by fines dropping into them. In charging the tanks the barytes is added to a depth of about 3 feet and then the dilute sulphuric acid solution, which is used as the solvent, is run in. Steam is admitted by means of the coiled lead pipe, which is closed at one end and provided with small perforations from 6 to 8 inches apart. The steam escaping from these perforations agitates and heats

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*Mr Edwin Higgins, Jr., *Engineering News*, Feb. 23, 1905, and *Engineering and Mining Journal*, Vol. LXXIX, 1905, p. 465.

the mixture, which requires from 6 to 80 hours to bleach, depending entirely on the amount of iron contained in the barytes. After drawing off the acid, the cleaned mineral is discharged either by sluicing through a specially constructed spout or else by shoveling over the side of the tank, and is transferred to a washer in which the last traces of the acid and clay material are removed. The cleaned mineral is then dried, either on large pans or by means of some one of the patented rotary driers.

In this bleaching process the manganese dioxide is not removed and the barytes that contains this impurity has to be ground to paste on a 40-mesh screen and then mixed with nitrate of soda, salt, and sulphuric acid in the proper proportions. This mixture is then heated in a specially constructed furnace, by which process the iron and manganese are converted into chlorides, which, being very soluble in water, can be completely removed by washing, the barytes being allowed to settle in a series of tanks, generally three in number.

The next step in the preparation of the barytes for market is reducing it, first to the size of fine sand by means of rolls, and then to an impalpable powder by means of buhr-stones, after which it is ready to be packed for shipment.

PRODUCTION.

In 1904 the production of crude barytes in North Carolina amounted to 13,413 short tons, valued at $33,930. This quantity and value represents the crude barytes after it has been mined and hand-cobbed ready for shipment to the mill, but does not include the further cleaning as described under the bleaching process. This production is an increase of 6,578 tons in quantity and $12,583 in value as compared with the production of 1903, which was 6,835 short tons, valued at $21,347. The average value per ton of the 1904 production was $2.53, which is 59 cents less than the average value, $3.12 per ton, of the production of 1903. This production was obtained from Madison and Gaston counties, with by far the larger amount from the former County. In the following table there is given the production of barytes in North Carolina for the years 1901 to 1904, inclusive:

PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA, 1901-1904.

YEAR.	QUANTITY, SHORT TON.	VALUE.
1901	6,890	$ 20,865
1902	14,679	44,130
1903	6,835	21,347
1904	13,413	33,930

MONAZITE AND ZIRCON.

MONAZITE.

Monazite is essentially an anhydrous phosphate of the rare earths, cerium, lanthanum and didymium, but usually contains a small and varying percentage of thoria. It varies considerably in color, being light-yellow to honey-yellow, reddish, brownish and yellowish-green, and it has a resinous to vitreous luster. It is brittle, breaking with a conchoidal to uneven fracture, and is from 5 to 5.5 in hardness. The mineral is heavy, having a specific gravity of 4.64 to 5.3. By means of its color and specific gravity it can usually be readily identified.

It is the presence of thoria in the monazite that gives it its commercial value. There is, however, a considerable variation in the percentage of thoria found in the pure monazite, and consequently in the commercial product, which is in the form of sand and contains from 3 to 9 per cent. of this oxide. The thoria is used in the manufacture of the mantles for the Welsbach and other incandescent gas-lights. The Welsbach light consists of a cylindrical hood or mantle composed of a fibrous network of the rare earths, the top of which is drawn together and held by a loop of platinum wire. When in use, this mantle is suspended over the flame of a burner constructed on the principle of the Bunsen burner, in which the heating, instead of the illuminating, power of the hydrocarbons of the gas is used by burning it with an excess of air. In this manner the mantle becomes incandescent and glows with a brilliant and uniform light. In the manufacture of these mantles a cylindrical network about 1½ inches in diameter is woven out of the best and strongest cotton thread, which is first washed in ammonia and then in warm water, being wrung out in a mechanical clothes-wringer each time. The next operation is the soaking of this cotton network in a solution of the rare earths, after which it is dried in a revolving hot-air bath. This network is then cut to a length required for the hood; the cylindrical pieces are shaped over a wooden form, the upper end being drawn together by means of platinum wire. The cotton fiber is eliminated by heating the mantles over a hot Bunsen burner flame, thus leaving the hood composed of the thoria and other chemical compounds. During the burning of the cotton thread there is some shrinkage in the size of the hood. The exact composition of the hoods is not generally known, as it is a trade secret, but they are composed largely of thoria, with smaller quantities of the lanthanum and didymium oxides.

A portion of the cerium obtained in the reduction of the monazite is prepared for market in the form of the oxalate, and is used in the drug trade.

There have been a great many chemical compounds made of the rare earths from monazite in the chemical laboratory of the Welsbach Lighting Company, of Gloucester City, N. J., and considerable experimental work has been done to determine whether these compounds were of any chemical use. A series of experiments* were made to determine as to the chemical value of some of these rare earth compounds as mordants. The results of these experiments were that there were no commercial uses that could be made of these compounds as mordants.

Some interesting scientific results have been recently obtained regarding the relation of uranium and radium, some of which were obtained from experimental work upon monazite.† In this experimental work it has been shown that the proportionality between the uranium and the radium contents of minerals is constant. In carrying out these investigations a series of 22 separate samples, comprising 12 distinct mineral species, were used, among which were four samples of monazite, one from North Carolina in the form of sand and containing 5 per cent. of thoria and 0.43 per cent. of uranium; one from Connecticut, representing a massive specimen which contained about 8 per cent. of thoria and 0.30 per cent. of uranium; a third from Norway, representing a single good-sized crystal, and containing from 7 to 9 per cent. of thoria and 0.41 per cent. of uranium; and the fourth from Brazil, which was in the form of sand, and contained about 5 per cent. of thoria and 0.31 per cent. of uranium. The results obtained in the examination of the monazite minerals are given, together with the results of the other minerals, under the head of Uranium Minerals, on page 49.

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*Jour. of Soc. of Chem. Ind., Feb., 1904, p. 104.

†Origin of Radium, by B. B. Boltwood, Philosophical Magazine of London, 1905, p. 599

One of the interesting facts brought out by Mr. Boltwood's investigations in their reference to monazite is that the thorium has apparently no participation in the production of radium and that the radioactivity of monazite is due to its uranium contents.

ZIRCON.

Zircon is a silicate of zirconium ($ZrSiO_4$) and is commonly found in clear, tetragonal prisms terminated by the pyramid. It is usually of a grayish, light-brown to reddish-brown color, although it is occasionally found colorless to red and perfectly transparent, when it becomes of value as gem material. It is 7.5 in hardness and has a specific gravity of 4.65. The economic use made of this mineral, besides that which is used for gems, is in the preparation of zirconia, this oxide being used, together with yttria and other oxides, in the manufacture of the glower for the Nernst electric lamp. Besides the oxides of yttrium and zirconium, which are the principal ones contained in the Nernst glower, there are also very small amounts of erbium, cerium, uranium, thorium, and perhaps others of the rare earths.

Nernst Lamp.—The fundamental principle of this Nernst lamp is that certain of the rare earths or refractory oxides will conduct an electric current and glow after they have been heated to redness. This discovery, which was made by Dr. Nernst in 1897, has resulted in the development and perfecting of the glower which is now embodied in the Nernst lamp. This glower is composed of a mixture of the rare earth oxides and is made in the form of a small rod or pencil of chalk-like material, having wire terminals at either end. When cold the glower is an insulator, but by means of the wire the glower becomes heated to redness when a current is passed through these wires, and its resistance gradually decreases until it has reached a red heat, when with 220 volts across the terminals it starts to conduct the current and give light.

In bringing a glower up to its starting point corresponding to a temperature of 1,200° F., use is made of a small electrical heater composed of two or more small tubes, of porcelain, about 1½ inches long and ¼ inch in diameter, which are overwound with fine platinum wire, this being in turn held in place and protected from the intense heat later generated by the glower by an outer coating of porcelain paste. After the glower becomes heated, there is, of course, no further use for the heater, and it is cut out by a small electro-magnet cut-out, which consists of a magnetic coil connected in series with the glower, an armature, and the necessary contacts in the heater circuit. Thus, when the glower has become heated sufficiently, the current begins to pass through it, and when this becomes sufficiently strong the armature is attracted and the contacts are separated, thus disconnecting the heater from the line. The surface of the glower before being used presents a smooth, white, porcelain or chalky appearance, but after having been in use about 500 hours it is rough or crystalline in appearance.

The yttria contents used in the manufacture of the Nernst glower are obtained principally from the mineral gadolinite, which has not thus far been found in North Carolina. There are, however, a number of minerals containing yttria, such as samarskite, euxenite and fergusonite, which have been found in the State. It may be of interest to give here a list of the principal minerals containing the yttrium oxides, although but few of them have thus far been found in sufficient quantity to be a commercial source of yttria.

LIST OF PRINCIPAL YTTRIUM MINERALS.

Yttrocerite.—A fluoride of calcium, with the metals of the cerium and yttrium groups, which has been found sparingly at Amity, Orange County, N. Y., and at Mount Mica, near Paris, Me. This mineral contains about 14.8 per cent. of yttria oxide and 9.3 per cent. of cerium oxide.

Tengerite.—A hydrous yttrium carbonate, with something of a chalk-like appearance, which occurs as thin coating on gadolinite at Ytterby, Sweden, and in Llano County, Texas.

Cappelenite.—This mineral is a borosilicate of yttrium and barium, with smaller quantities of cerium, lanthanum, and thorium oxides. It crystallizes in the hexagonal system in thick prisms, and has a conchoidal fracture. Its color is a greenish-brown, and it has a vitreous to greasy luster. This mineral has not thus far been identified in the United States, but has been found sparingly in Lille Aro, on the Langesund Fiord, in southern Norway.

Gadolinite.—This is a basic orthosilicate composed principally of beryllium oxide (glucina), iron protoxide, and the yttrium oxides. The yttria earths, or, as they are sometimes called, the "gadolinite earths," are partially replaced by the oxides of cerium, lanthanum, and didymium. Many of the gadolinite specimens also show a very small quantity of thoria, this being less than 1 per cent. The mineral crystallizes in the monoclinic system, commonly prismatic and terminated by the base. The crystals are usually rough and coarse, showing no cleavage, but having a conchoidal to splintery fracture. It is a brittle mineral, and has a hardness of 6.5 to 7. It varies considerably in specific gravity, according to the percentage of yttrium oxides, from 4 to 4.5. In color, gadolinite is greenish-black, and sometimes brown; in thin splinters it is nearly transparent, and usually of a grass-green to olive-green color. Its luster is vitreous to greasy. The principal occurrence of gadolinite is in pegmatitic dikes or veins; and it is very often associated with allanite and other minerals containing some of the rare earth oxides.

Yttrialite.—This is an amorphous mineral whose chemical composition is chiefly a silicate of thorium and yttrium oxides, with smaller quantities of cerium, lanthanum and didymium oxides. The percentage of yttrium oxides is 46.50, and of the thorium oxide 12 per cent. It has a vitreous to greasy luster, and in color, on a fresh fracture, it is olive green, approaching drab. On the exterior surfaces it is usually altered to orange yellow. It occurs associated with gadolinite at the Llano County (Texas) locality, and is often found implanted upon it. When first found, this mineral was called green gadolinite, but its true character was determined by Messrs. W. E. Hidden and J. B. Mackintosh, who gave it the name yttrialite. It has been found at this locality in masses of considerable size, one piece weighing approximately 10 pounds.

Allanite.—This mineral occurs quite commonly in the pegmatitic dikes throughout the United States, and in some localities it has been found in some considerable quantity. It is a silicate of calcium, aluminum, and iron, with the rare earth oxides, cerium, lanthanum, and didymium, and smaller quantities of the yttrium oxides. The cerium oxides run up as high as 27 per cent., while the yttria oxides are usually less than 3 per cent. No commercial value at the present time is attached to this mineral. Allanite is a pitch-brown to black mineral with a submetallic to pitchy or resinous luster, and occurs sometimes in well-developed monoclinic crystals and also massive and in embedded, angular, or rounded grains. In the pegmatitic dikes of Massachusetts, Connecticut, Virginia, North Carolina, and Colorado, allanite is a rather commonly associated mineral.

Cenosite.—This mineral is a hydrous calcium-yttrium silicate and carbonate, containing about 37.6 per cent. of yttrium oxides. It is a mineral of a yellowish-brown color and greasy luster, which is thus far known only in the single specimen that was found on the island of Hitterö, Norway.

Rowlandite.—This is an yttrium silicate that occurs in massive form associated with the gadolinite of Llano County, Texas. It occurs but sparingly and is of a pale drab-green color when pure, but alters to a waxy, brick-red mineral. An analysis gave 61.9 per cent. of the yttrium oxides.

Fergusonite.—This mineral is essentially a metaniobate and tantalate of yttrium with cerium, uranium, etc. The percentage of yttrium oxides varies from about 18 to 26 per cent. It is a mineral with a rather characteristic brownish-black to liver-brown color and a rather dull luster. Its specific gravity is high, being 5.8. It usually occurs massive, but occasionally well-developed tetragonal crystals have been observed. It has been found at a number of localities, either in granite or in pegmatitic dikes, as in granite at Rockport, Mass., and Amelia, Va., and in many of the mica mines of Mitchell County, N. C., and associated with gadolinite in Llano County, Texas. At this latter locality it has been found in masses weighing over a pound.

Yttrotantalite.—This mineral is essentially a tantalate and niobate of iron, calcium, and the rare earth oxides, yttrium, erbium, cerium, and uranium. The yttria contents of this mineral vary from about 10 to 19 per cent. It is of a black to brownish-yellow color, with a submetallic to vitreous luster, and has a specific gravity of about 5.8. It has been found in but small quantity at Ytterby, Sweden.

Samarskite.—This mineral is one of the more abundant minerals containing the rare earth oxides, very large quantities of it being found at the Wiseman mine, in Mitchell County, N. C. It is essentially a niobate and tantalate of iron and calcium with the cerium and yttrium metals, together with the uranium oxide. The yttrium oxides vary from 6 to 15 per cent. and the cerium oxides from about 2 to 6 per cent. The color of samarskite is velvet black, and its luster varies from vitreous to resinous and splendent. It is commonly found massive or in flattened embedded grains, but occasionally in fairly well-developed, prismatic, rhombohedral crystals. Its usual occurrence is in pegmatitic dikes, and the most noted locality is the Wiseman mica mine, in Mitchell County, where it has been found in masses over 20 pounds in weight. At other mica mines in North Carolina it has been found more sparingly.

Euxenite.—This is a niobate and titanate of yttrium, erbium, cerium, and uranium, which occurs commonly massive and is of a brownish-black color. It has a brilliant to sometimes greasy luster. It has been found at Jolster, Norway, but has not thus far been identified in the United States, unless one of the alteration products of samarskite found at the Wiseman mine, in Mitchell County, can be referred to this mineral.

Polycrase.—This mineral is principally a niobate and titanate of yttrium, erbium, cerium. and uranium similar to euxenite. Its yttrium oxide contents vary from 13 to 27 per cent. It is found usually in orthorhombic, prismatic crystals, which have a conchoidal fracture. It is black in color and of a vitreous to resinous luster. It has been found in the United States near Zirconia, Henderson County, N. C., and in South Carolina about 4 miles from Marietta, Greenville County.

The demand for zircon and gadolinite is limited, for the reason that in the manufacture of the Nernst lamp there is but a very small quantity of these oxides used, and even with a very large increase in the number of Nernst lamps used there would be but a very small increase in the demand for these minerals. This, to a certain extent, is also true of monazite, although this mineral is still mined much more extensively than the other two and there is a considerably larger demand for it.

PRODUCTION.

The total production of monazite in North Carolina during 1904 amounted to 685,999 pounds, valued at $79,438. As compared with the production of 773,000 pounds, valued at $58,694, in 1903, this is a decrease of 87,001 pounds in quantity, but an increase of

$20,744 in value. The above quantities represent the purified sand containing from 85 to 99 per cent. monazite. The large increase in the value of the production with the decrease in the quantity, as compared with the production of 1903, is due to the higher percentage of monazite contained in the sand prepared for market. This production was obtained from the following counties, given in the order of the importance of their productions: Cleveland, Burke, McDowell, Rutherford, and Lincoln.

The production of zircon in 1904 was 1,000 pounds, valued at $200, and was obtained from Henderson County. This makes the total production of these minerals mined for use in the manufacture of various lamps amount to 686,999 pounds in quantity, valued at $79,638. In the table below there is given the production and value of monazite and zircon mined in North Carolina from 1893 to 1904:

PRODUCTION OF MONAZITE AND ZIRCON IN NORTH CAROLINA FROM 1893 TO 1904.

YEAR.	MONAZITE.		ZIRCON.	
	POUNDS.	VALUE.	POUNDS.	VALUE.
1893	130,000	$ 7,600	------------	$----------
1894	546,855	36,193	------------	------------
1895	1,573,000	137,150	------------	------------
1896	30,000	1,500	------------	------------
1897	44,000	1,980	------------	------------
1898	250,776	13,542	------------	------------
1899	350,000	20,000	------------	------------
1900	908,000	48,805	------------	------------
1901	748,736	59,262	------------	------------
1902	802,000	64,160	2,000	380
1903	773,000	58,694	3,000	570
1904	685,999	79,438	1,000	200

TANTALUM AND URANIUM MINERALS.

During the past few years there has considerable interest arisen regarding tantalum and uranium minerals on account of the value of tantalum for use in the manufacture of the tantalum lamp and of the relation of uranium to radium. Minerals containing tantalum and uranium have been found in a number of localities in North Carolina, and the uranium minerals have been used to some considerable extent in experimental work regarding radium. The demand for minerals containing tantalum is not large and at the present time is limited to the amount of this metal that is used in the manufacture of the tantalum lamp. The demand for the uranium minerals depends upon their radium contents, and while at the present time there is a large demand for these minerals that are high in radio-activity, yet the market for such minerals must necessarily be, at the present time, more or less uncertain.

TANTALUM MINERALS.

The demand for tantalum in the commercial world has only arisen within the last year, and is due to the discovery that this metal is capable of withstanding the highest temperature obtained in an incandescent light and that it can be obtained of sufficient ductility to permit of being drawn into very fine wire which has little tendency to break up when heated by the electric current. The results of the investigations with tantalum by the firm of Sieman & Halske have led to the invention and manufacture of the "tantalum lamp," in which the incandescent material is tantalum wire that is capable of withstanding the highest temperatures. Although experimental work was carried on with a number of metals, it was not until tantalum was tried that a metal was found of sufficient ductility and high melting point to answer the purposes desired. After tantalum had been proved to be the metal desired for the manufacture of these incandescent lamps, it was then necessary to locate sources of supply of this metal.

There are quite a number of minerals that contain this metal, but it is nearly always associated with niobium. The most common and familiar minerals containing tantalum are columbite and tantalite, two minerals that are very closely associated with each other, and are niobates and tantalites of iron and manganese. They pass by almost insensible gradations from a normal columbite, which is the nearly pure niobate, containing about 77.9 per cent. of niobium pentoxide and but a trace of tantalum pentoxide, to normal tantalite, which is the nearly pure tantalite, containing about 84 per cent. of tantalum pentoxide and only a trace of niobium pentoxide. Of these two minerals the columbite is by far the commoner and occurs in the greater abundance. These minerals occur both massive and crystallized. The crystals are orthorhombic and usually prismatic. They are iron-black to brownish-black in color, and are frequently iridescent. They vary very considerably in specific gravity according to the increase in the percentage of tantalum pentoxide. The nearly normal columbite is 5.3 in specific gravity, while the nearly normal tantalite is 7.8. The common occurrence of these minerals is in pegmatitic dikes and the columbite is quite commonly found in small quantity in many of the pegmatitic dikes of western North Carolina. In some of them it has been found in considerable quantity, as in the mica mines of Mitchell and Yancey Counties, principally the Wiseman mine of Mitchell County and the Ray mine of Yancey County. At the latter mine very large crystals of columbite have been found that measure 8 x 4 x 2 inches.

There are a number of other minerals that contain tantalum, some of which might become sources of supply of this metal, but for the most part, however, they assay much smaller percentages of tantalum pentoxide than either columbite or tantalite, or else they have been found but very sparingly. There is given below a list of the principal ones of these minerals, together with their chemical composition and the principal localities at which they are known to occur:

MINERALS CONTAINING TANTALUM.

Hatchettolite.—This mineral is a tantalo-niobate of uranium with calcium oxide and a small quantity of iron oxide. The percentage of tantalum pentoxide in this mineral is about 29 per cent. It is a yellowish-brown mineral, having a resinous luster and occurs sparingly, associated with samarskite, at a number of the mica mines in Mitchell County, principally the Wiseman mine.

Samarskite.—This mineral has already been described under the yttria minerals. It contains a much higher percentage of niobium pentoxide than tantalum pentoxide. It occurs in considerable quantity at the Wiseman mica mine in Mitchell County.

Microlite.—This mineral is essentially a calcium pyro-tantalate, with a considerable variety of other bases in small quantities. It is a pale yellow to brownish mineral with a resinous luster, which has been found sparingly in octahedral crystals at Chesterfield, Mass.; Branchville, Conn., and Amelia, Amelia County, Va., where it occurs in pegmatitic dikes, often associated directly with columbite. The tantalum pentoxide in this mineral is about 68.5 per cent. On account, however, of the scarcity of this mineral, it does not represent one that will be apt to become a source of supply of tantalum.

Fergusonite.—This mineral has also been described under the yttria minerals. While it usually contains but from 2 to 10 per cent. of tantalum pentoxide, occasionally specimens have been found containing as high as 27 per cent. of tantalum pentoxide. It does, however, occur in some quantity, and as a source of both yttrium oxide and tantalum it may become of some considerable commercial value.

Tapiolite.—This mineral is essentially a tantalate and niobate of iron. It has thus far been observed in but one locality near the village of Sukala, Finland. It has been observed but sparingly and occurs in pyramidal, tetragonal crystals of a pure black color and a strong, adamantine luster. Its percentage of tantalum pentoxide is 73.9.

Yttrotantalite.—This mineral has been described under the yttria minerals. Besides the yttrium oxides, it contains 46.25 per cent. of tantalum pentoxide, and is another one of those minerals that might become a source of both the yttrium oxides and tantalum. It is, however, of rather rare occurrence, having been found at but few localities in Sweden, principally at Ytterby.

Hielmite.—This rare mineral is essentially a stannotantalate of yttrium, iron, manganese, and calcium, and has been found very sparingly at the Kararfvet mine, near Falun, Sweden. Its color is pure black, and it has a metallic luster. It occurs usually massive, without any apparent cleavage, but occasionally it is in rough, orthorhombic crystals. It contains from 54 to 72 per cent. of tantalum pentoxide.

URANIUM MINERALS.

All of the uranium minerals have become of special interest within the past few years, since the discovery of radium. This is especially true since uranium has been shown to be the direct source of radium. In the article on the "Origin of Radium"* referred to above, it has been shown that uranium is the source of radium and that there is a constant proportionality between the uranium and the radium in the various minerals containing these elements. There was a series of 22 uranium minerals examined for their uranium and radium contents, including specimens from very widely separated localities, and specimens that varied very widely in their percentage of uranium. In the following table the results obtained in the examination of these uranium minerals are given. Column I gives the activity of the emanations contained in one gram of the mineral; column II, the activity of the emanation lost by one gram of the mineral at ordinary temperatures; column III, the sum of the two previous activities (total emanation equivalent to the radium content in one gram of the mineral); column IV, the percentage of the total emanation lost by diffusion from the cold mineral (the emanating power of the mineral at ordinary temperatures); column V, the weight (in grams) of the uranium content in one gram of mineral; column VI, the ratio of the radium to the uranium (the number obtained on dividing the total activity, column III, by the quantity of uranium, column V).

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*Philosophical Magazine of London, April, 1905, p. 599.

COMPARATIVE RESULTS OBTAINED IN THE EXAMINATION OF MONAZITE AND OTHER MINERALS.

No. of Specimen.	Substance.	Locality.	I.	II.	III.	IV.	V.	VI.
1	Uraninite	North Carolina	150.7	19.3	170.0	11.3	0.7465	228
2	do	Colorado	147.1	8.0	155.1	5.2	.6961	223
3	Gummite	North Carolina	126.7	20.3	147.0	13.7	.6538	225
4	Uraninite	Joachimsthal	131.8	7.8	139.6	5.6	.6174	226
5	Uranophane	North Carolina	108.0	9.7	117.7	8.2	.5168	228
6	Uraninite	Saxony	112.5	3.1	115.6	2.7	.5064	228
7	Uranophane	North Carolina	88.8	24.7	113.5	22.8	.4984	228
8	Thorogummite	do	61.1	11.8	72.9	16.2	.3317	220
9	Carnotite	Colorado	41.6	8.1	49.7	16.3	.2261	220
10	Uranothorite	Norway	24.9	.3	25.2	1.3	.1138	221
11	Samarskite	North Carolina	23.2	.16	23.4	.7	.1044	224
12	Orangite	Norway	22.84	.26	23.1	1.1	.1034	223
13	Euxenite	do	19.8	.10	19.9	.5	.0871	228
14	Thorite	do	15.6	1.0	16.6	6.2	.0754	220
15	Fergusonite	do	11.95	.07	12.0	.5	.0557	215
16	Aeschynite	do	9.98	.02	10.0	.2	.0452	221
17	Xenotime	do	1.14	.40	1.54	26.0	.0070	220
18	Monazite	North Carolina	.88	.00	.88	--------	.0043	205
19	do	Norway	.84	.01	.85	1.2	.0041	207
20	do	Brazil	.76	.00	.76	--------	.0034	223
21	do	Connecticut	.63	.00	.63	--------	.0030	210
22	Allanite	North Carolina	.014	.00	--------	--------	(0.00007)	------

From the data given in the table it is evident that a direct proportionality (within the limits of experimental error) exists between the quantities of radium and the quantities of uranium, and the inevitable and only possible conclusion is that uranium is the parent of radium. The participation by thorium in the production of radium, which has been suggested by some, is entirely excluded, since the radium-uranium ratio in the thorites, containing approximately 50 per cent. of thorium, is the same as that in such minerals as carnotite and uranophane, where the content of thorium is not over a few hundredths of a per cent. at the highest.

As is seen from the above table, of the 22 specimens examined 8 were from North Carolina. It is interesting to note that the uraninite, specimen No. 1, which was from the Flat Rock mine, Mitchell County, showed the highest radio-activity of any of the minerals examined.

The sources of supply of these uranium minerals in North Carolina have been confined almost entirely to the pegmatitic dikes of Mitchell and Yancey counties, the former having produced the greatest amount. The mine that has produced the largest quantity of uranium minerals is the Flat Rock mine, near Spruce Pine, Mitchell County. Other mines that have produced smaller amounts of uranium minerals are the Buchanan, Wiseman, and Deake mines, in Mitchell County, and the Ray mine, Yancey County. As far as

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can be judged from the work done on the pegmatitic dikes containing these uranium minerals, none of them contain them in sufficient quantity to be worked for these minerals alone. When, however, they are operated as sources of mica, the uranium minerals would be obtained as valuable by-products.

There are many minerals containing uranium that are known at the present time, but they are for the most part found but sparingly and some of them are only known from one locality. The only ones that have been found in sufficient quantity to become a source of uranium are uraninite, gummite (an alteration product of uraninite) and carnotite. The first two have been found in some quantity in the western part of North Carolina, but the third was identified and described from Colorado, and has thus far only been found in a few places in Colorado and the adjoining counties of Utah.

Uraninite, or, as it is more commonly known, pitchblende, is a uranate of uranyl and lead, with usually thorium (or zirconium), and sometimes with the metals of the lanthanum and yttrium groups. Certain varieties contain nitrogen, and several of the newly discovered and rare elements, as helium, radium, and polonium. This mineral is usually massive and botryoidal, with a conchoidal to uneven fracture, and is brittle. Crystals are rare, the octahedron being the common form. It has a hardness of 5.5 and a specific gravity of 9 to 9.7. In appearance it is often pitch-like, having a submetallic to greasy and dull luster, and a grayish, greenish-black to velvet-black color.

Uraninite, which is the name given to the crystallized variety, occurs as a constituent in many pegmatitic dikes and coarse granites, and is the variety that generally carries the rare earths and nitrogen. The massive variety, pitchblende, usually contains none or but a very small amount of the rare earths and nitrogen, and is more commonly found as an associate in metalliferous veins, with the sulphides of silver, lead, copper, nickel, iron, and zinc.

Uraninite suffers alteration quite readily, going over into the hydrated mineral, gummite, which looks like gum, and whose exact composition is not known. Crystals of gummite are observed only as pseudomorphs after uraninite; and it is more often in rounded or flattened pieces, with a greasy luster and a reddish-yellow to orange, hyacinth-red or reddish-brown color, the brighter colors being the more prominent. It is only 2.5 to 3 in hardness and has a specific gravity of 3.9 to 4.2. As would be naturally expected, gummite is to be found at nearly all the uraninite localities, masses of this mineral often being found as a distinct mineral. A further alteration of the uraninite, through gummite, is to the mineral uranophane or uranotil, which is found in masses of a fine fibrous structure, with a vitreous luster and a honey-yellow, lemon, or straw-yellow color. It is a hydrous silicate of calcium and uranium, and besides being found as an alteration product, it also occurs as a distinct mineral. It is not uncommon to find the uranophane surrounding a mass of gummite, in the center of which is a nucleus of uraninite.

In the following table the name and composition of the minerals containing uranium in sufficient amount to classify them as uranium minerals are given, and those that have been identified in North Carolina are in italics:

LIST OF MINERALS CONTAINING URANIUM.

Uraninite.—Described above.

Gummite.—Described above.

Uranophane (or *Uranotil*).—Described above.

Uranothallite, a hydrous calcium uranium carbonate, $2CaCO_3$. $U(CO_3)_2 .10H_2O$, occurs very sparingly as an incrustation of a siskin-green color on uraninite.

Liebigite, a hydrous calcium uranium carbonate, formula perhaps $CaCO_3(UO_2)CO_3.20H_2O$, occurs rarely as an apple-green crystalline incrustation on uraninite.

Voglite, a hydrous carbonate of uranium, calcium, and copper, of an emerald-green to grass-green color, is sparingly found in aggregates of crystalline scales implanted on uraninite.

Schröckinergite and randite are two uranium calcium carbonates of uncertain composition.

Some of the varieties of thorite contain a considerable quantity of uranium as uranothorite, which carries over 9 per cent. of uranium oxide, U_2O_3, and is found in the Champlain iron district, New York, but whose exact locality is unknown.

A number of the niobium and tantalum minerals contain from 2 to 15 per cent. uranium oxide. They are, in the order of their percentage of uranium: Blomstrandite, *hatchettolite*, *samarskite*, *polycrase*, *euxenite*, *fergusonite*, ythotantalite, annerödite, and hielmite.

Uranosphaerite, a hydrous bismuth uranate (BiO_2). $U_2O_7.3H_2O$ occurs sparingly in half-globular aggregated concentric forms of an orange-yellow color.

Torbernite, a hydrous phosphate of uranium and copper, $Cu(UO_2)_2 + P_2O_8$, occurs in foliated micaceous aggregates of an emerald to grass-green color, closely resembling autunite.

Zeunerite is a hydrous copper uranium phosphate, $Cu(UO_2)As_2O_8+8H_2O$, similar in appearance to torbernite.

Uranospinite is a hydrous calcium uranium arsenate, probably $Ca(UO_2)_2As_2O_8+8H_2O$, and similar to autunite, but rare.

Uranocircite is a hydrous barium uranium phosphate, $Ba(UO_2)_2P_2O_8+8H_2O$, similar to autunite, but very rare.

Phosphuranylite, a hydrous uranium phosphate, $(UO_2)_3P_2O_8+6H_2O$, sometimes carrying lead, is found sparingly as a deep lemon-yellow incrustation on quartz and feldspar at some of the uraninite localities.

Trögerite, a hydrous uranium arsenate, $(UO_2)_3As_2O_8+12H_2O$, in thin lemon-yellow crystals, has been found very sparingly at the Bald Mountain mining district, Black Hills, South Dakota.

Fritzscheite, a mineral resembling autunite, but of a reddish color, which is attributed to manganese, is of doubtful composition, but shows reactions for uranium, vanadium, manganese, phosphorus, and water.

Walpurgite, a basic arsenate of bismuth and uranium, $Bi_{10}(UO_2)_3(OH)_{24}(AsO_4)_4$, is very rare.

Johannite is a hydrous sulphate of uranium and copper, of a beautiful emerald-green color.

Uranopilite, a hydrous calcium uranium sulphate, perhaps $CaU_8S_2O_{31}..25H_2O$, has been found as a velvety incrustation of a yellow color on uraninite.

Uraconite, or uranocher, is an amorphous earthy mineral of a fine lemon-yellow color, whose composition is principally a hydrous uranium sulphate.

Medjidite, uranochalcite, zippeite, and voglianite are uranium sulphates of uncertain composition, containing from 36 to 79 per cent. of uranium oxides.

PRODUCTION.

There was a small production of uranium minerals during 1904 from some of the mines in Mitchell County, obtained principally from working over the old dumps of the Flat Rock mine. The value of these uranium minerals obtained was approximately $160, consisting principally of uraninite and gummite.

TALC AND SOAPSTONE.

INTRODUCTION.

Talc is one of the more prominent minerals that is being mined in North Carolina and, on account of the quality of talc that certain of the mines produced, it is widely known and in greater demand than the mines can supply. This talc is that which is found in Swain County, principally at the Hewitt mine, it being very pure and sufficiently compact so that it can be used for the manufacture of tailor's pencils, gas tips, etc. These deposits are unique, and there are no others known at the present time in the United States that can furnish talc of this quality. Inquiries are constantly being received regarding talc and soapstone deposits, most of which refer to a talc of superior quality like that obtained from the Hewitt mine, and also for a talc that is sufficiently pure for grinding into flour talc for use in the manufacture of talcum powder. Thus, any deposit in the State that contains talc of the right quality for this purpose is worthy of sufficient development work to prove the quantity of the mineral. Talc of such quality brings a good price and does not have to be as favorably located for transportation facilities as the inferior grades and soapstone varieties.

The inferior grades of talc, even though they can be used in the powdered condition for certain purposes, as certain soapstones and pyrophyllite, are not in as large a demand and of course command but a low value as compared with the other quality, and are used principally for foundry facings.

The soapstone variety of talc is sometimes ground to a flour talc and used for foundry facings in the manufacture of paper, etc.; but its principal use is in the manufactured articles, such as tubs, table tops, griddles, ovens, etc. There is but very little of this variety of talc that is utilized in North Carolina on account of the distance of the deposits from railroad transportation. It is, however, used in some amount each year in the mountain counties, principally Alleghany, Ashe, Mitchell, and Yancey, for fire-places, chimneys, etc.

PRODUCTION.

The total production of talc and soapstone of all varieties in North Carolina during 1904 amounted to 3,801 tons, valued at $65,483. As compared with the production of 1903, of 5,331 short tons, valued at $76,984, this is a decrease of 1,530 tons in quantity and of $11,501 in value. The large decrease in tonnage is due principally to the large falling off in the production of the pyrophyllite variety of soapstone from Moore County. The counties making this production of talc in 1904 were Swain, Moore, Cherokee, Jackson and Ashe, given in the order of the importance of their productions, there being a total of five producers, exclusive of those quarrying stone for fire-places and chimneys. The soapstone quarried for fire-places, etc., was obtained principally from Ashe County.

The value of the talc production given above includes that of the manufactured products made from talc, as there is but a small quantity of the production that is sold in the crude state. The production is classified, therefore, as it is marketed as rough, manufactured, ground, and for chimney purposes. In the following table the conditions in which the 1904 production was marketed is shown, together with that for the years 1902 and 1903:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1901, 1902 and 1903.

CONDITION IN WHICH MARKETED.	1902.		1903.		1904.	
	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.
Ground talc for powders, etc.	3,381	$ 31,628	3,762	$37,606	3,163	$ 32,217
Talc cut into pencils, gas tips, etc.	371	42,017	265	27,615	208	28,673
Talc sold crude	1,487	15,317	1,304	11,763	430	4,417
Soapstone cut into slabs for chimneys, etc.	--------	----------	--------	--------	--------	175
Total	5,239	88,962	5,331	76,984	3,801	65,483

In the table below there is given the quantity and value of talc and soapstone produced in North Carolina from 1898 to 1904, inclusive.

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1904, INCLUSIVE.

YEAR.	QUANTITY.	VALUE.	YEAR.	QUANTITY.	VALUE.
	Short Tons.			*Short Tons.*	
1898	1,695	$ 27,320	1901	5,819	$ 77,974
1899	1,817	31,880	1902	5,239	88,962
1900	4,522	75,308	1903	5,331	76,984
			1904	3,801	65,483

PRECIOUS STONES.

There are few States that furnish the variety of precious stones, or gem minerals that are found in North Carolina. Some of these minerals are of special interest, as they have thus far been found only in this State. These are rhodolite, which has only been found in Macon County, and hiddenite, which has only been found in Alexander County.

Perhaps the more common and popular use of the terms gem, gem mineral, and precious stone is in their application to the precious and semi-precious minerals which are suitable for cutting into gems to be used in jewelry. This, however, is a somewhat restricted use of these terms as they are now used in the arts. The names, gem mineral or precious stone, are at the present time given to those minerals which are either suitable for cutting into gems for jewelry; or are used in various polished forms as ornaments; or are of a rare occurrence and make striking and beautiful mineral specimens. For instance, in illustrating the first class, the diamond, ruby, sapphire, etc., could be cited; representatives of the second class would be the minerals malachite, serpentine, quartz, etc.; while of the third class there would be rhodochrosite, pyrite, etc. The gem minerals constituting the first class are, of course, the most important and will demand the most attention.

There has been but little systematic mining for precious stones in North Carolina, and the only two companies who have really engaged in mining for these stones are the American Gem and Pearl Company, of New York, and the American Gem Mining Syndicate, of St. Louis, whose properties are located in Mitchell and Macon counties respectively. The former produced many varieties of beryl and the latter rhodolites, a variety of garnet.

The principal minerals which have been found in North Carolina that are valuable as gems are:

Diamond.
Corundum (7 varieties).
Almandite (Garnet).
Rhodolite (Garnet).
Pyrope (Garnet).
Beryl (3 varieties).
Hiddenite.
Quartz (12 varieties).
Cyanite.
Opal.
Peridot (Olivine).
Spinel Ruby.
Gahnite.
Zircon.
Tourmaline.
Rutile.
Oligoclase (Moonstone).
Staurolite.

The gem minerals that offer the greatest possibilities commercially are beryls, garnets, hiddenite, and corundum minerals, including ruby, sapphire, etc.

GARNET.[*]

Garnet is a name given to a group of minerals that have very similar physical properties, except color, but are different in chemical composition. They crystallize in the isometric system with the dodecahedron and the tetragonal tris-octahedron as the most common simple forms. They are all orthosilicates of calcium, magnesium, iron or manganese with aluminum, iron, or chromium. In the following table are given the different varieties of garnets that have been recognized:

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[*] For a more detailed description of the gem minerals of North Carolina, see *The Southland,* Vol. I, p. 1, and *Bulletin of N. C. Geological Survey,* now in press.

I. ALUMINOUS GARNETS.

Grossularite (Essonite)	$Ca_3Al_2(SiO_4)_3$
Pyrope	$Mg_3Al_2(SiO_4)_3$
Rhodolite	$2Mg_3Al_2(SiO_4)_3Fe_3Al_2(SiO_4)_3$
Almandite	$Fe_3Al_2(SiO_4)_3$
Spessartite	$Mn_3Al_2(SiO_4)_3$

II. IRON GARNET.

Andradite (Demantoid)	$Ca_3Fe_2(SiO_4)_3$

III. CHROMIUM GARNET.

Uvarovite	$Ca_3Cr_2(SiO_4)_3$

Of the above, the essonite, pyrope, rhodolite, almandite and uvarovite constitute the members of the garnet group that are used for gems. There is, however, a green variety of the andradite, known as demantoid, that has been found in the Ural Mountains, that is used as a gem.

Essonite.—This garnet is also known as cinnamon garnet or cinnamon stone and hyacinth of the jeweler (although the true hyacinth is a zircon). It has been found in beautiful transparent, flat crystals between plates of mica near Bakersville, North Carolina, some of which would cut into gems of a carat or more in weight.

Pyrope.—This variety of garnet has been found in Burke, McDowell, and Alexander counties, in the gravels of the gold and placer deposits. These are of a nearly blood-red color and have furnished some good gems.

Almandite.—This is one of the commonest of the gem garnets and varies in color from a pinkish or scarlet, through brownish-red to deep red. These have been found very extensively in North Carolina and Georgia, especially in Burke and Caldwell counties. Some of these garnets have weighed 20 pounds, and although they were not of sufficient purity to be cut into gems, they might be used for cutting into dishes. Those of gem quality would only furnish very small stones. A great deal of this garnet has been used in the manufacture of sandpaper or garnet-paper. Near Hall Station, Jackson County, North Carolina, an almandite garnet occurs in the gneissic rock, from which it is separated and used in the manufacture of garnet wheels for abrasive purposes. When the scarlet and crimson varieties are cut *en cabochon* they are sometimes called carbuncles.

Rhodolite.—This garnet is remarkable for its color and beauty as a gem stone. It has a peculiar and beautiful tint that in part belongs to that of the rhododendron and the rose, and this, combined with its transparency and brilliancy, is most striking in artificial light. Most garnets are beautiful only by transmitted light and then are apt to exhibit only dark shades of color, but the rhodolite gives the most beautiful effects of brilliant and varied coloring by reflected light. It has been found only in Macon County, North Carolina, in the streams which head in Mason's Mountain and in places on this mountain. Some stones have been cut that were as high as 13$\frac{3}{8}$ carats in weight.

None of the green garnets have as yet been found in North Carolina.

The garnets are very common in their occurrence and are apt to occur abundantly in crystals or rounded grains, in mica schists, gneiss, granite, and sometimes crystalline limestone. In the pegmatitic dikes or granitic veins which are the source of mica, garnet is usually quite abundant, and in many of the mica mines extending from Virginia through North Carolina, Georgia, and Alabama, garnets of gem quality have been found. Many of the garnets found in these veins are the andradite varieties.

During 1904 garnet was one of the principal precious stones mined.

BERYL.

Beryl is a silicate of beryllium and aluminum and crystallizes in the hexagonal system, usually in well-developed six-sided prisms. In color it varies from emerald green, pale green to sea green, passing into yellow, light blue, and white. The emerald-green color is due to the presence of a little chromium, and is a variety that is highly prized as a gem when clear and free from flaws. The beryl emerald is the emerald that is commonly sold at the present time, the oriental or true emerald (the green variety of sapphire) being one of the rarest of the gem stones. The finest emeralds are found in New Grenada and Siberia. The South has furnished some very handsome beryls of emerald-green color, some of which have cut into fine stones. The most noted locality is near Hiddenite, Alexander County, North Carolina. The general surface of the country is rolling, having an average altitude of about 1,000 feet above sea-level. The rocks are covered by 25 or more feet of soil, which has resulted from the decomposition of a gneissic rock which underlies it. The first emeralds that were obtained at this locality were found in the soil, and it was not until 1881, when the Emerald and Hiddenite Mining Company was organized, that any direct mining was undertaken. The location of the deposits favorable to these gems is recognized by the float, quartz crystals, and mica observed on the surface, for these have only been slightly moved from the place where they originated. As the deposits were followed downward through the soil the unaltered rock was encountered, and as the work was extended into this, their exact occurrence was seen. They occur in pockets of quartz, associated with rutile, hiddenite, quartz, muscovite, dolomite, pyrite, garnets, etc., all of which are well crystallized. The rutile found here is the finest that has been observed in any locality in the world. The quartz associated with the emeralds is exceptionally well crystallized and has furnished some of the most modified crystals ever found. It has been observed that most of the emeralds have been found where the quartz crystals are not so highly modified (although they are well crystallized), and the hiddenite occurs with the quartz, which does not show these many modifications. These pockets vary from some that are simply a slight widening of a seam of quartz to the average, which are about 6 inches wide and a foot to 18 inches long, to one that was open, which was large enough for a man to enter. The rock, which is gneissoid in character, is scarred by small seams of quartz, many of which have a nearly east and west strike and dip toward the north. The seams are usually very narrow, from half an inch to an inch or two in width, and as these are followed downward, they broaden very considerably just before a pocket is encountered. There are other seams of quartz in these rocks that are very irregular in strike and dip, and none of this character have as yet been observed that have developed into pockets containing gems. The largest emerald crystal found here was a very perfect specimen of a fine but somewhat light-green color which has doubly terminated and weighed 8¾ ounces. One of the largest stones cut weighed 4 23-32 carats and was of a somewhat light-green color.

On Crabtree Mountain, between Brush and Crabtree Creeks, Mitchell County, emerald beryl occurs in a pegmatitic vein. No very large crystals have as yet been found at this locality, but some have been taken out that have cut small gems of a deep emerald color. The most satisfactory results have been obtained by cutting the emerald in the matrix, *en cabochon*. These have attracted considerable attention and they make very attractive stones.

The aquamarine variety of beryl is found very commonly in many of the pegmatitic dikes that have been worked for mica in Virginia and North Carolina. The most important of these are the Wiseman mine, Mitchell County; the Ray mine, Yancey County, and the Littlefield mine, Macon County, where transparent aquamarine beryls have been found very abundantly that have cut many beautiful gems. Besides the aquamarine, blue beryl has been found in fine crystals in the mines of Mitchell County near the Yancey County line, as has also yellow or golden beryl. The Wiseman mine, near Spruce Pine, Mitchell County, has produced the greatest quantity of aquamarine, golden, yellow, and blue beryls. This mine has been operated by the American Gem and Pearl Company, of New York, who were the largest producers of precious stones in the State during 1904. The largest pieces of beryl found during this year would not cut stones much over 10 carats in weight, although some pieces have been found that cut stones over 20 carats in weight.

CORUNDUM GEMS.

As a gem mineral corundum is very prominent, as it furnishes not only a variety of gems, but also some of the rarest. This mineral varies very widely in color, being found ruby red, sapphire blue, dark blue, various shades of green, violet purple, rose, pink, brown, yellow, gray, colorless, and black. The corundum gems are determined by the color and there are at the present time nine varieties that are commonly recognized by the lapidaries. In the arts the principal ones are usually prefixed by the word "oriental" to distinguish them from other gems called by the same name, but whose mineral composition and characteristics are entirely different. These nine varieties of corundum gems are given in the following table:

Name.	*Color.*
Oriental or True Ruby	Pigeon blood, red and shades of red.
Oriental Sapphire	Corn flower blue and shades of blue.
Oriental Emerald	Green.
Oriental Amethyst	Purple.
Oriental Topaz	Yellow.

Pink Sapphire	Rose or pink.
White Sapphire	Colorless.
Diamond Spar	Colorless.
Girasol	Pale blue or bluish white.
Opaline	Pale blue or bluish white.
Hyaline	Pale blue or bluish white.
Star Sapphire	Opalescent.
Chatoyant	Opalescent.
Asteria	Opalescent.

All these varieties of corundum gems have been found in North Carolina, although some of them have been found but very rarely, while others occur in some quantity.

Rubies of good color and even of the pigeon-blood color have been found at the Corundum Hill mine, Macon County, and in Cowee Valley, Macon County. The former locality has furnished a greater variety of corundum gems than any other, these having been found of ruby color, various shades of green, yellow, blue, pink, and colorless. At the latter locality the prevailing color is a ruby red.

The best sapphires have been found at the Corundum Hill mine, Macon County, and the Sapphire and White Water mines, Jackson County.

With the exception of the mining for rubies in Cowee Valley, there has not been any systematic mining for corundum gems in the State. The Corundum Hill mine offers some possibilities of furnishing various gems of some considerable value, if mining were conducted particularly for them.

HIDDENITE.

This gem mineral has only been found at the emerald (beryl) locality at Hiddenite, Alexander County, which has been described above. This gem is the green variety of spodumene, the pink variety being known as kunzite. On account of the rarity of this gem and because the locality has not been worked for many years, the gems are valued and sold at fabulous prices.

OTHER GEM MINERALS.

Amethysts are obtained in many localities, but for a number of years there has not been any definite mining for them, although a few are obtained each year from Iredell, Lincoln, and Macon counties. Perfectly clear, colorless quartz and smoky quartz also occur in some abundance, and crystals and pieces are constantly being found and sold, chiefly as mineral specimens. Rutile, zircon, and cyanite of sufficient purity to cut into gems are also occasionally found, although most of the material is only of value as mineral specimens.

PRODUCTION OF PRECIOUS STONES.

The total value of the production of precious stones of all kinds in North Carolina during 1904 amounted to $10,600, which is an increase of $9,075 as compared with $1,525, the value of the 1903 production.

In the following table is given the production of precious stones in North Carolina since 1900:

PRODUCTION OF PRECIOUS STONES
IN NORTH CAROLINA SINCE 1900.

YEAR.	VALUE.
1900	$ 12,020
1901	24,245
1902	5,300
1903	1,525
1904	10,600

GRAPHITE.

On account of the many uses for which graphite is adapted, and because the large demand for this mineral is only partly supplied by that produced in the United States, it is a mineral that has always attracted considerable interest in the mining industry. Although graphite is mined in only a very small amount in North Carolina, yet on account of the large demand for it and from the fact that there are numerous occurrences of this mineral throughout the State, it is one of the minerals regarding which inquiries are constantly being received. The pure mineral is composed simply of carbon, but is often impure from the presence of iron sesquioxide, clay, mica, etc. Even the purest forms of graphite, as they are found in nature, will yield upon combustion from a fraction of 1 per cent. upward in ash. Some of the graphite from the Ticonderoga (New York) deposits has given as low as 0.24 of 1 per cent. of ash. This mineral crystallizes in the rhombohedral division of the hexagonal system, and, when crystallized, is usually in six-sided tabular crystals that are nearly always striated and whose faces are indistinct. It is commonly found in embedded, foliated masses, or in scaly, slaty, or micaceous masses; occasionally it is in granular to compact formation, and at other times it is of a decidedly earthy texture. It has a perfect basal cleavage, similar to a mica, and the thin laminæ are flexible, but not elastic. Graphite varies considerably in specific gravity— from 2.09 to 2.23— according to the amount of impurities. The hardness also varies, for the same reason, from 1 to 2. Graphite has a metallic luster when pure, and varies from this to dull and earthy, according to the percentage of impurities. The color, for the same reason, also varies from iron-black to dark steel-gray. It has a greasy feel, is a conductor of electricity, is impervious to atmospheric influences, is combustible only at very high temperatures, and is very soft. It is these properties of graphite that make it of so much value in the arts and adapt it to such a large variety of uses.

The sources of supply of graphite in the United States have been chiefly deposits in New York, Pennsylvania, Wisconsin, Michigan, Alabama, Rhode Island, Georgia, and Ohio. It has, however, been found in small quantities in nearly all of the western and eastern States. The foreign localities, which furnish over three times what is produced in this country, are principally in the Island of Ceylon, which produces a crystalline graphite, and from Austro-Hungary, which produces an amorphous graphite. A very small amount is obtained from Mexico.

USES.

The uses of graphite are very numerous and varied. One of the chief uses is in the manufacture of crucibles, retorts, and other refractory apparatus, and for this purpose it is the crystalline variety that is most extensively used. It has been estimated that 55 per cent. of the crystalline graphite is used for this purpose and only a very small percentage of the amorphous variety. Other uses of the crystalline graphite are as follows: About 15 per cent. of the total production for the manufacture of stove polishes, about 10 per cent. for foundry facings, about 5 per cent. for paint (the bulk of the graphite used for this purpose being of the amorphous variety), and 15 per cent. in the manufacture of pencils, powder glaze, electrotyping, steam packing, and electrical supplies. With the exception of the Georgia amorphous graphite, which is used in coloring fertilizers, the bulk of the amorphous graphite mined is used in the manufacture of paint and for foundry facings.

In the manufacture of good grades of pencils, lubricants, electrical supplies, and crucibles, it is essential that a nearly pure graphite be used, this being especially true of the lubricants and of the best quality of pencils. For paints and foundry facings, purity is not so essential, and therefore the amorphous varieties can be used with as good results as the crystalline. The uses of graphite as a lubricant have been constantly increasing, and now there are many forms of graphite lubricants on the market. Many reasons are advanced for the more universal introduction of graphite as a lubricant, such as the fact that graphite permanently fills up all the minute irregularities or roughnesses on metal surfaces, thus making them absolutely smooth and even; that it also reduces frictional resistance; is not crushed or squeezed out by great pressures; prevents sizing and cutting; is unaffected by any degree of heat that would be attainable in a cylinder or bearing; is not decomposed by the action of anything to which it would be subjected, and that it does not corrode metals with which it would come in contact. It must, however, be an absolutely pure graphite, without any gritty matter or iron oxide in it. About 1,200 tons of amorphous graphite are used in the manufacture of paints. In some of the States the whole production of graphite is used for this purpose, while in others the whole production is used for foundry facings. Only a few of the producers utilize the graphite themselves for manufacture into commercial products, and it is usually sold direct by the miners or producers to the manufacturers of paint or to foundrymen.

Besides the crystalline and amorphous graphite, there is the artificial graphite, which nearly equals in quantity the production of crystalline graphite in this country. This product is used in the manufacture of electrical supplies, pencils, crucibles, and the other various purposes for which the natural graphite is used.

PRODUCTION.

There was but a small production during 1904, all of which was obtained from Wake County, amounting to 100 tons, valued at $525. This is an increase of 50 tons in quantity and of $277 in value as compared with the production of 50 tons, valued at $248, in 1903. This, however, is a decrease of 730 tons in quantity and of $3,775 in value as compared with the production of 830 tons, valued at $4,300, in 1902. These graphite deposits are low grade and do not furnish the finer grades of commercial graphite for which there is the greater demand. These deposits have been described in detail in previous reports.*

In the following table there is given the production of graphite from 1901 to 1904:

PRODUCTION OF GRAPHITE IN NORTH CAROLINA FROM 1901 TO 1904.

YEAR.	QUANTITY.	VALUE.
	Tons.	
1901	95	$ 559
1902	830	4,300
1903	50	248
1904	100	525

The total production of graphite in the United States during 1904 was 21,955 tons, valued at $341,372, of which only about 6,000 tons were used for the ordinary purposes of graphite, the bulk of the production being used as a coloring material in the manufacture of fertilizers. This graphite, however, was valued at only about $1.25 per ton. Besides this natural production of graphite in the United States, there was also manufactured 1,624 tons, valued at $217,790, of artificial graphite, practically all of which was consumed in the United States. To this should be added the amount of graphite imported into the United States, which, during 1904, was 12,674 tons, valued at $905,681, making the total amount of graphite consumed in the United States 37,627 tons, valued at $1,452,326. If there is deducted from this figure the amount of graphite used as a coloring material in fertilizers, it leaves the total consumption of graphite 22,627 tons, valued at $1,431,326. The above illustrates the importance of the graphite industry and shows the quantity and value of this material that is used each year in the United States.

Thus any graphite deposit that may be located in North Carolina is worthy of sufficient development in order to determine whether it contains a sufficient quantity of this mineral to make it a commercial proposition.

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*N. C. Geological Survey, Economic Paper No. 6, 1901, p. 68, and Economic Paper No. 8, 1903, p. 48.

COAL.

The coal fields of North Carolina are confined principally to Chatham and Stokes counties, the coal measures in each district being associated with the Triassic sandstones. Neither of these fields is extensive or capable of being developed into very large productive properties. The Chatham County deposits have been the most extensively developed and are the only ones that have been thus far worked on a commercial scale, and those that have been worked for the past few years are the Cumnock mines. The coal measures of Stokes County are near Walnut Cove, and they have been prospected to a considerable extent, but no systematic development work has been undertaken to accurately determine their real value nor the quantity of coal. Seams of coal have been exposed in this district that were 5 feet wide, containing 3 feet of a hard, compact coal, and the other two feet running more into fines. No work was done on these Walnut Cove deposits during 1904 beyond a little desultory prospecting.

PRODUCTION.

The quantity of coal produced in North Carolina during 1904 was only 7,000 tons, valued at $8,820, as compared with the production of 17,309 tons, valued at $25,300, in 1903. This is a decrease of 10,309 tons in quantity and of $16,480 in value. In the following table there is given the quantity and value of coal produced in North Carolina from 1900 to 1904:

PRODUCTION OF COAL IN NORTH CAROLINA FROM 1900 TO 1904.

YEAR.	QUANTITY.	VALUE.
	Tons.	
1900	18,000	$ 22,500
1901	3,723	5,585
1902	23,000	24,500
1903	17,309	25,300
1904	7,000	8,820

STONE.

INTRODUCTION.

Stone suitable for building purposes occurs very abundantly throughout North Carolina and is of great variety, although at the present time there are but few deposits that have been thoroughly developed and operated. The stones that are now being utilized, either for building purposes or for making roads, are granite, which includes various types of granites, gneisses and associated crystalline, siliceous rocks; sandstones and quartzites; marbles and limestones. Besides these, there are dikes of basic, intrusive rocks, including principally diabase and diorite, which have been quarried and utilized to some extent for road purposes. The slates and serpentines, which occur quite abundantly in certain portions of the State and of good quality, have not as yet been developed to any great extent.

As the above stones are quarried, there will be noted considerable variation in their color and texture, which may often make the stone undesirable and objectionable, while at other times the color of the stone may be its most desirable characteristic and increase its value considerably over an equally good and desirable stone of a different color. A stone must also be able to withstand exposure to weather without crumbling, rusting or flaking, if it is to give the best satisfaction and be able to compete with other stones. In determining whether a stone is available for building purposes, consideration must be given to its quantity; ease and cheapness with which it can be quarried; its distance from market; and its transportation facilities.

On account of the comparative low price of stone when it is weighed, it is very important that it have ready and easily accessible means of transportation, for stones prepared for building purposes are very heavy and, therefore, expensive to handle. It will also be found that in working stone of the same variety, but from different quarries, that a wide difference will be observed in the ease with which the stone can be quarried, cut and prepared for building purposes. In general it may be said that a stone of fine and even grain will work more readily than one that is coarse.

There is now in press, as Volume III of the publications of the North Carolina Geological Survey, a volume on the "Building Stones of North Carolina," which takes up in detail a description of the various stones that are found in the State, with descriptions of occurrences, localities, etc.

Although there are so many deposits of stone throughout the State suitable for building purposes, there has been little or no advance made in the development of these deposits during the past two years, except at two or three localities, which are described beyond under the heads of the different stones. In 1904 the total value of the production of all kinds of stone in North Carolina was considerably less than it has been for the past three years. During 1904 the value of the total production of building stones was $312,576, which, as compared with $360,322, the value of the production of 1903, is a decrease of $47,746.

There is given in the following table the value of the production of the various stones quarried in 1902, 1903, and 1904:

PRODUCTION OF BUILDING STONE DURING 1902, 1903, AND 1904.

STONE.	1902.	1903.	1904.
	VALUE.	VALUE.	VALUE.
Granite	$ 338,749	$ 334,357	$ 292,439
Sandstone	4,825	600	250
Marble and Limestone	23,153	25,365	19,887
Total	$ 366,727	$ 360,322	$ 312,576

GRANITE.

Granite is very widely distributed through certain areas of the State, but there are only two localities where the granite industry has been developed to a large extent. These are in the vicinity of Mt. Airy, Surry County, and in the vicinity of Faith, Rowan County, these two counties producing two-thirds of the total production of granite. The chief operator in Surry County is the North Carolina Granite Corporation, whose quarries are located about 1¼ miles northeast from the town of Mt. Airy, the county-seat. This is the most active quarry in the State. These quarries were first opened in 1889 by the Mt. Airy Granite Company, and since that date work has been continued steadily by this company, until the first of January, 1898, when they were leased to Thomas Woodroffe & Sons, who operated them continuously to July 1st, 1904, when the entire business was sold to the North Carolina Granite Corporation, who are now actively engaged in developing and operating these quarries. The quarries are located in a 40-acre tract of nearly continuously exposed granite, which crosses over the slope and top of a long hill, which is 100 feet or more above the valley bottom, in which there is a railroad track that operates between the quarries and Mount Airy. The stone is handled from the quarries to the railway cars by a system of inclined cableways. The stone occurs in nearly solid masses and has been stripped over nearly all of the exposed area. The rock is of a very light gray, nearly white biotite granite of medium texture, containing no visible injurious minerals. The constituent minerals, feldspar, quartz, and biotite, are not evenly distributed through the mass of the granite, but there are some areas in which the rock is composed almost entirely of quartz and feldspar, making a rock of extreme whiteness. Where the rock is of uniform color, it forms an excellent and desirable stone for the purposes for which granite is used, except, perhaps, for monumental purposes. For this latter use there is hardly sufficient contrast of color between the cut and polished surfaces.

In operating the quarries, a suitable place, usually the brow of some small knoll, is selected, where a hole about 3 inches in diameter is drilled to the depth desired for making the sheet or raise of stone, which is usually from 5 to 7 feet in thickness. This hole is then charged with a quarter of a pound of dynamite which, upon exploding, pulverizes the stone slightly at the bottom of the hole and forms a small chamber. This hole is then cleaned out and recharged in the same way, using, however, instead of dynamite, black powder. This is kept up until a small seam has been started at the bottom of the hole, which extends parallel with the surface. The recharging with light charges of powder is then continued, increasing the charges gradually until the seam extends in all directions from the bottom of the hole and for a distance of 75 feet or more from the hole. The use of the explosive is then discontinued and a water-tight connection made to the hole by cutting off a piece of iron pipe of a suitable length and cementing it in the hole with melted sulphur. To this is attached an ordinary hand force-pump, and water is then pumped into the crevices which have been formed by the explosives. By means of continuous pumping of water into the crevices, this is extended until it covers an area sometimes as much as two acres in extent and finds vent by tearing out to the thin edges on the side of the hill. As stated by Mr. Thomas Woodroffe, vice-president of the company, they experience no difficulty in raising sheets of stone in this manner covering from 1 to 2 acres, and from 6 to 8 feet in thickness close to the hill. After the pump is started to work it usually requires but a few hours of steady pumping to force the sheet out to the thin edge. He also states that it is necessary to clean off a ledge of stone made in this manner before attempting to form another sheet on the surface below, and that the best results are obtained in the hottest weather. The present company is making some very extensive improvements on the property, equipping it with a large stone-cutting plant, which will be supplied with the most modern stone-working appliances. The stone, which is used in considerable quantity as a building stone and also for curbing and paving blocks, is being shipped largely to Cincinnati, Philadelphia, Baltimore, Washington, and to numerous smaller places throughout Pennsylvania, Ohio, Maryland, Virginia, Tennessee and North Carolina. In a recent communication from Mr. Thomas Woodroffe, the shipments of stone per year from the Mount Airy quarries since July 3, 1890, when the first shipment of stone was made, are shown to be as follows:

ANNUAL SHIPMENTS OF STONE FROM MOUNT AIRY QUARRIES.

YEAR.	CARS.	YEAR.	CARS.
1890	135	1898	1,333
1891	264	1899	1,474
1892	334	1900	1,113
1893	523	1901	1,055
1894	952	1902	1,138
1895	834	1903	1,203
1896	548	1904	1,282
1897	1,044		

As is seen from the above table, the shipments of 1900 to 1904, inclusive, are less than the shipments for the years 1898 and 1899, but the net value of the product at the quarries was materially advanced in the latter years, this difference being accounted for by a larger volume of dressed stone having been handled where formerly there was a much greater quantity of rough stone.

The other locality, which has been the scene of the greater amount of the stone quarrying in the State, is in Rowan County, at Dunn's Mountain, which is located about 4 miles east of Salisbury, the

North Carolina
Library.

county-seat. The principal village in the vicinity is Faith. This mountain is a part of a conspicuous granite ridge some 12 to 14 miles in length. Its elevation is about 900 feet above sea-level and 150 feet above Salisbury. The granite of this ridge is of two distinct colors, one a very light gray to nearly white and the other a decided pink or flesh-colored stone. From Phillips Mountain, near the village of Faith in a southwestward direction, the granite of the ridge is of the very light gray to nearly white color, with none of the pink granite visible. Granite of a more or less pronounced pinkish color has been found over all parts of Dunn's Mountain proper, and this pink granite extends at intervals as far south as the village of Faith, where several openings have been made in it. Beyond this point, however, in a southwesterly direction, the granite is entirely of a light gray color. Between Dunn's Mountain proper and the village of Faith most of the rock is light gray, although there are a number of quarries that have been operated in the pink granite that is between these points.

There have been numerous quarries opened at this granite formation, of which the principal ones are the Dunn Mountain quarries (McCanless), the Rowan Granite Company's quarries, the Balfour Quarry Company's quarries, the Phillips Mountain quarries, and the Powler's Mountain quarries. At the McCanless or Dunn's Mountain quarries the rock is uniformly light-gray granite of medium texture and of excellent working qualities. In places the granite assumes a pinkish-gray color, but this is not intense enough, as shown by the granite exposed at the present time, to warrant the quarrying for a pink granite.

The Rowan Granite Company's quarries are located within a few hundred yards of the Granite Quarry Station on the Salisbury and Norwood Branch of the Southern Railway. Some 12 to 15 openings have been made in different places over the 300-acre tract of land owned by this company, and the two largest openings will average about 200 feet long by 150 feet wide and have been worked to an average depth of 32 feet. From these quarries dimension stones weighing 70 to 100 tons each have been quarried. The color of the stone quarried is a light-gray granite, more or less speckled in places, with a pinkish tinge. The stone is used as a general building stone and also for curbing and paving blocks, and in smaller quantity for ornamental work and as ballast. It has been used in Washington and many of the larger places in Virginia and North Carolina.

The Balfour Quarry Company's quarries are located within less than half a mile south of the Rowan Granite Company's quarries, near Granite Quarry Station. The principal quarry of this company is in a beautiful pink granite. This granite is a very attractive stone, not only for general building, but also for monumental and decorative purposes. It is of a uniform color and texture and is susceptible of a very high polish.

About one mile southwest of the village of Faith is a very large, low, conical peak known as Phillips Mountain, which marks the southwest extension of Dunn's Mountain. The stone, as exposed in the quarries on this mountain, is of a very light-gray biotite granite of a uniform color and texture and is suitable for nearly all grades of work. There are a number of small openings that have been made on this mountain that have been worked to a more or less extent, although none have been developed into a quarry of any large size.

Three miles southwest of Faith is a low mass of granite which is known locally as Powler's Mountain, which marks the southwest extension of the granite ridge. There has been but little work done in this mass of granite beyond several small openings that were made several years ago. The granite is light in color, composed largely of feldspar and quartz, and as far as could be observed, contains no injurious minerals.

The above two districts represent the largest granite-producing areas in the State, although there are a number of other districts in which granite of excellent quality is known to occur.

Production.

In 1904 the total value of all the granite produced was $292,439, a decrease of $41,918 as compared with the value, $334,357, of the production of 1903. Considering the many granite localities throughout the State and the quality of the granite in these areas, this production does not begin to represent what the granite industry of the State should attain, for many of the quarries are well located for railroad transportation and the occurrences of the stone are such that they can be quarried very economically. The number of operators quarrying granite during 1904 was 14, who worked at 18 different localities in the following 10 counties, given in the order of the importance of their productions: Surry, Rowan, Rockingham, Buncombe, Polk, McDowell, Orange, Henderson, Vance, and Gaston.

The first three counties, in the order of the value of production in 1903, were Surry, Rowan, and Buncombe. Gaston County, with two operators, was lowest in the value of its production in 1904 and also in 1903. Approximately one-fourth of the granite produced in the State during 1904 was used for building and monumental purposes and amounted in value to $75,632. This is a decrease of $51,854 as compared with the value, $127,486, of the granite used for the same purpose in 1903. There was a large increase in the value of the granite used for curbing and flagging, which in 1904 was valued at $101,632, which, as compared with $68,099, the value of the granite used for these purposes in 1903, is an increase of $33,533. There is given in the table below the different purposes for which the granite quarried in the years 1901 to 1904 were used:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901-1904.

USES.	1901.	1902.	1903.	1904.
Building and monumental purposes	$108,574	$167,639	$127,486	$ 75,632
Paving blocks	10,662	6,986	30,780	15,807
Curbing and flagging	56,245	82,615	68,099	101,632
Crushed stone for road-making, railroad ballast, etc.	89,425	77,759	102,524	93,296
Other purposes	--------	3,750	5,468	6,072
Total value	264,906	338,749	334,357	292,439

SANDSTONE.

In North Carolina sandstone occurs as portions of triassic, carboniferous and silurian rocks, but the only ones that have been developed or worked in North Carolina are the triassic beds. The color of these sandstones varies somewhat throughout the belt, but they are principally of red-brown hue. One drawback to the development of the sandstone beds of the State has been the abundant jointing that has developed in the beds, which causes the stone in many of the deposits to break into blocks of rather small size.

The principal deposits are located in Anson, Moore, Chatham, Wake, and Durham counties. In some of these counties no systematic quarrying has been done for a great many years, and in others but little work has been done, which has simply been to supply a local demand for this stone. In Anson County the principal quarrying has been done at the old Linehan quarry, on the Jessie Edwards estate, 1¼ miles northwest of Wadesboro; at the Wadesboro Brownstone Company's quarry, about 1½ miles northwest of Wadesboro. This quarry furnished what is known as the "Wadesboro brownstone," which for a number of years was used quite extensively as a building stone. In Moore County the principal quarrying has been in the vicinity of Carthage, and some of the most promising sandstone deposits in the State have been found here. There have also been some good quarries developed in the vicinity of Sanford, of which the principal one is the Carrington & Gonella quarry. There are no quarries at the present time in operation in Chatham County, although some promising outcrops of sandstone have been located on the banks of Deep River and also at Haw River. The development of any quarries on Deep River would be favorably located for transportation, as the river could be used for transporting the stone by means of barges to railroad centers.

Production.

In 1904 the production of sandstone had decreased to a value of $250 and the stone was obtained from Anson County. In 1903 there was only a production that amounted to $600 in value. In the table below is given the value of the production of sandstone for the years 1901 to 1904:

PRODUCTION OF SANDSTONE IN NORTH CAROLINA, 1901-1904.

YEAR.	VALUE.
1901	$11,682
1902	4,825
1903	600
1904	250

MARBLE AND OTHER FORMS OF LIMESTONE.

Limestones, either as the compact variety or as marble, are not very abundant rocks in North Carolina and have been observed in the southeastern counties of New Hanover and Craven as coarsely cavernous shale limestones and more compact limestones which can and have been used locally for rough construction work and for road-building. A semi-crystalline limestone occurs in Catawba, Lincoln, and Gaston counties, and marbles in McDowell, Cherokee, and Swain counties.

Small areas of limestone also occur in Madison, Buncombe, and Henderson counties.

The above deposits have been mentioned and described in previous reports, and full descriptions of the localities and occurrences are given in the report on Building Stones, which is now in press.

Recently a new deposit of marble has been discovered in the State, which is exposed in a cut on the South and Western Railway, near the mouth of Sink Hole Creek on the north bank of North Toe River, about 3½ miles above Toe Cane Station. The marble is pure white in color and rather coarsely crystalline. Its texture is uniform and it is exceptionally pure and homogeneous throughout. The bed has an average thickness of about 60 feet.

A similar outcrop of marble has been found on the land of Mr. W. F. Jackson, on the north side of Sink Hole Creek. The location of the deposit is favorable for quarrying, as it is on a mountain-side a hundred feet above the valley, thus affording good dumping ground for waste material and can also be naturally drained.

The marbles of Cherokee County have continued to be worked during 1904 by the National Marble Company, at their quarry, and the stone that they have taken out and put on the market has found a ready sale for monumental and also for building purposes.

A new limestone quarry has recently been opened in Buncombe County, about 2 miles from Fletcher, a station on the Southern Railway. It is on the same limestone strata as the old Lance property, but is 600 or 700 feet distant from this old quarry and on what is known as the Westfeldt property. The property is operated by the Blue Ridge Lime Company, which was incorporated under the laws of North Carolina in 1904. The quarry and kilns are connected by a tramway with the railroad at Fletcher. The company has erected two modern kilns, which have a capacity of 700 bushels per day.

This rock is of a peculiar fine-grained structure with a very smooth touch. An analysis of this stone by Mr. D. K. Pope, of the United States Assay Office at Charlotte, gave the following results:

ANALYSES OF LIMESTONE FROM FLETCHER, NORTH CAROLINA.

MINERAL.	I.	II.
	Per Cent.	*Per Cent.*
Silica	1.40	1.70
Alumina and ferric oxide	.58	.58
Lime	53.32	53.38
Magnesia	1.62	1.32
Carbonic acid	43.66	43.39
Total	100.58	100.37

There are little or no impurities in the limestone, and the calcium carbonate constitutes 95.32 per cent. of the rock. A test was made also by Mr. Pope of this limestone by burning Sample I at a strong red heat for two hours, at the end of which time 95.74 per cent. of the theoretical amount of lime was obtained. The stone burned easily and made a pure white lime. In Sample II, which was heated for two hours at a strong red heat, there was 90.3 per cent. of the stone converted into lime, which was also a very white lime and gave no difficulty in burning. Another hour's heating would have converted practically all of the rock into lime.

There is a large demand for lime in North Carolina, which at the present time is being supplied largely from Tennessee and Virginia, and the development of any limestone deposits in the State for the purposes of manufacturing lime are of a decided value to the State.

Production.

The total production of marble and other forms of limestone in North Carolina during 1904 was valued at $19,887, which is a decrease of $5,478 as compared with the production of 1903, which was valued at $25,365. The larger proportion of this production was used for road building and curbing. The production was obtained from New Hanover, Buncombe, Cherokee, and Henderson counties, given in the order of the importance of their productions. All the production from Henderson and Buncombe counties was used in the manufacture of lime. In the following table is given the value of the production of limestone from 1901 to 1904:

PRODUCTION OF MARBLE AND OTHER FORMS OF LIMESTONE, 1901-1904.

YEAR.	VALUE.
1901	$ 8,357
1902	23,153
1903	25,365
1904	19,887

SLATE.

There was no production of slate in North Carolina during 1904.

DECORATIVE STONES.

There are a number of stone deposits throughout the State of various kinds which are capable of being developed into decorative stones which should have some considerable commercial value and demand. The principal deposits are the pink granite in the vicinity of Dunn's Mountain, near the village of Faith, Rowan County, which has been described above; and an orbicular diorite which occurs 10 miles west of Lexington and one mile west of Oaks Ferry, on the Yadkin River. This rock is of a dark color with a greenish tinge, which is produced by nodules of a dark-green hornblende which are lying close together and often touching each other, while the intervening areas are filled with a clear, white, lustrous feldspar. A considerable portion of this diorite is distinctly orbicular, while other portions are more granitic. This rock dresses well under the hammer, takes a high polish, and is acted upon little, if any, by weathering, as is indicated by stone steps, posts, etc., made of this stone that have been used at the Hairston residence for over 50 years.

Another decorative stone is serpentine, which occurs quite prominently in a number of localities in North Carolina, principally in Madison, Wilkes, and Wake counties. The most favorable localities are between Weaverville and Leicester, Buncombe County, and a strip that crosses the French Broad River a mile above Alexander, and on the property of Mr. W. L. Foster, 2½ miles from Olivet, a station on the Southern Railway, and on land of W. E. Pounder, a short distance further southwest; near North Wilkesboro, Wilkes County, where the serpentine that has been obtained is of good color, hard, compact, and susceptible of a high polish, and is within ¾ of a mile of the railway; and in Wake County, on Barton Creek, about 14 miles northwest of Raleigh, on land belonging to Dr. A. J. J. Penny, Mr. Jesse Adams, and Mr. Joseph Tadlock.

CLAY.

The clay deposits of North Carolina continue to attract considerable attention, and there is a constant demand for kaolin or china clays, which is at the present time greater than can be supplied. The various phases of the clay industry in North Carolina offer very flattering opportunities for investment. When it is taken into consideration that there are in the State suitable clays for the manufacture of all kinds of earthenware, sewer-pipe, terra-cotta, porcelain-ware, decorative brick, fancy and pressed brick, it is with surprise that one, on investigation, learns that the larger part of these materials that are consumed in North Carolina are imported from outside the State. This is especially true of decorative and pressed brick, and in the many buildings throughout the State the bricks of this type which have been used in their construction have been imported. Although there has been an advance in the quantity and value of the brick produced in North Carolina each year for the past three or four years, yet there has been but little improvement in the quality of the brick manufactured and the manufacturers have not made any serious attempt to introduce any new methods or modern machinery in the manufacture of their brick. Thus, the average quality of the brick has been improved but little. The average value of the 143,988,000 brick manufactured in North Carolina during 1904 was $5.45 per thousand, which is an increase of 9 cents per thousand. While this average value of the common brick is all that they were probably worth, yet by exercising a little more care and with improved machinery, the quality of brick could be largely improved with but very little additional expense and would command a considerably higher average price per thousand. One reason for this low average value per thousand of these common brick is that too many have undertaken the manufacture of brick of this sort without knowing very much regarding the clay industry, or methods of manufacture of brick, or how to make a good quality of common brick. They are inexperienced in mixing the ingredients of the brick, in molding, stacking, and burning the brick.

The field for investment in the manufacture of pressed, fancy and vitrified brick is also large, as can be realized when it is known that out of the many millions of brick of this type that are used in North Carolina less than two million are manufactured within the State.

Another phase of the clay industry that should be very largely increased is the manufacture of earthenware, stoneware and decorative ware. At the present time this is but a very small industry in the State, while it is capable of becoming one of considerable magnitude, as the clays are in quantity and of the right quality for the manufacture of this type of clay products and there is a considerable demand for them in the State, as is evidenced by the quantity of these products that are being imported each year. These questions will be discussed more in detail under the subjects of the different clay products.

KAOLIN OR CHINA CLAY.

The principal changes in the kaolin industry of North Carolina since the publication of the last report are the production of kaolin from the deposit near Bostick's Mills, 4 miles north of Rockingham, Richmond County, and the development of the deposit of kaolin in Swain County on the headwaters of Panther Creek, near Almond. The principal supply of kaolin is still from the Harris mine, near Webster, Jackson County. There are other promising deposits of this clay near West Mills and Liberty Church, Macon County, and these deposits should soon have railroad transportation facilities, as the railroad from Tallulah Falls, Georgia, to Franklin, Macon County, has now reached the State line and is being pushed down the Little Tennessee Valley toward Franklin. Still other deposits that are worthy of investigation are 4 miles west of Troy, Montgomery County; near North Wilkesboro, Wilkes County; and in Beaver Dam Township, 2 miles southwest of Canton, Haywood County.

At the present time nearly all of the kaolin that is mined in the State is shipped to potteries at Trenton, N. J., or East Liverpool, Ohio, where it is used in the manufacture of tiling, for the better grades of porcelain and for the enamelling of brick. An extensive line of samples of these products made with North Carolina kaolin, principally from the Harris mine, Jackson County, was exhibited at the World's Fair, St. Louis, during 1904, and are now in a collection in the State Museum at Raleigh. All these materials and others, such as electric porcelain insulators, etc., which are now imported into the State, should be largely manufactured within the State from North Carolina kaolin and other pottery clay. This side of the clay industry should make a profitable investment, but it requires skilled workmen to undertake this work.

Production.

The production of kaolin in North Carolina during 1904 was from Jackson and Richmond counties, the total quantity mined being 9,110 tons, valued at $76,670. This is an increase of 505 tons in quantity and of $670 in value as compared with the production in 1903 of 8,605 tons, valued at $76,000. This, however, was a decrease of 4,202 tons in quantity and of $31,435 in value as compared with the production in 1902 of 13,322 tons, valued at $108,105. The average value per ton of the 1904 production was $8.41, which is a decrease of 42 cents as compared with the average value of $8.83 per ton of the 1903 production. This, however, is an increase of 30 cents per ton as compared with the average value of $8.11 per ton of the 1902 production.

There should be in 1905 a decided increase in the production of kaolin, due to the development of the Swain County deposits, which are being operated by the F. R. Hewitt Kaolin Company, of Almond, N. C., and also by the further development of the Richmond County deposits by the Richmond Mining Company, of Bostick's Mills.

POTTERY CLAY.

There has been little or no increase in the development of the pottery industry in North Carolina for the past 10 years, and during the past 4 years there has been a steady decline in the value of the manufacture of the line of clay products. There is no well-developed pottery industry in the State, and the small production is divided amongst 27 producers, the lowest value reported being $60 and the highest $2,465. The value of the production of most of these manufacturers is from $300 to $600, there being but three who made a production valued at over $1,000. A large part of this earthen and stoneware is crude and but little has been done to utilize any improved methods or to push this industry. There are plenty of clays in North Carolina suitable for making earthen and stoneware, which are the finer alumina sediments underlying the river terraces found in many of the broader valleys, the better clays being found usually near the shore line of the terrace. Such clays are found underlying the terraces along the Catawba River north of Morganton and Mt. Holly, Burke County, and near Blackburn and Catawba, Catawba County; the South Fork of the Catawba River, just north of Lincolnton, Lincoln County; the Yadkin River, near Wilkesboro, Wilkes County; and Elkin, Surry County; including the old terraces of the Deep River, near Ulah and Whynot, Randolph County. In the eastern part of the State, along the Cape Fear River, near Fayetteville, Cumberland County; the Neuse River, near Goldsboro, Wayne County; and Contentnea River, a tributary of the Neuse, in Wilson County, near Wilson, are similar deposits of clay.

Production.

The value of the production of pottery in North Carolina during 1904 was $13,900, which is a decrease of $412 as compared with $14,312, the value of the production of 1903. The number of pottery manufacturers engaged in making this production was 27, who were located in the following 9 counties, given in the order of the importance of their productions: Catawba, Lincoln, Buncombe, Wilkes, Randolph, Chatham, Union, Johnston, and Montgomery. In 1903 there were but 23 pottery manufacturers, who were located in the same counties as above, with the exception of Montgomery, which did not report in 1903 any production of pottery. Of the 1904 production, $438 was the value of the red earthenware and $13,462 the value of the stoneware. There were a few dollars of decorative ware reported, which is included under red earthenware.

There is a constant demand for this red earthenware and stoneware, and the pottery manufacturers should, with improved methods and by using better material for glazing the ware, be able to put a uniform and high-grade pottery on the market with but little additional expense, which would create a much larger demand for their products. For the development of this industry capital is needed as well as experienced men.

There was a small amount of pottery clay that was sold crude in 1904, amounting to 142 tons, valued at $61.

The values of the different grades of pottery produced during 1903 and 1904 are given by counties in the following table:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES IN 1903 AND 1904.

COUNTY.	1903.			1904.		
	EARTHEN-WARE.	STONE-WARE.	TOTAL.	EARTHEN-WARE.	STONE-WARE.	TOTAL.
Buncombe	$ 60	$ 2,200	$ 2,260	$ 31	$ 1,300	$ 1,331
Catawba		3,155	3,155		4,450	4,450
Chatham		2,000	2,000		600	600
Johnston	80	225	335	50	350	400
Lincoln	100	3,270	3,370	15	3,970	3,985
Montgomery				50	300	350
Randolph	222	1,320	1,542	150	1,040	1,190
Union	100	400	500	100	300	400
Wilkes	50	1,100	1,150	42	1,152	1,194
Total	612	13,700	14,312	438	13,462	13,900

FIRE-CLAY AND PIPE-CLAY.

There are a few localities in North Carolina which contain deposits of fire-clay, the more prominent ones being at Pomona, Guilford County; Grover, Cleveland County; Emma, Buncombe County; and near Archdale, Randolph County. There is but little work being done at any of these fire-clay deposits, and during 1904 it was confined to the deposits in Buncombe and Randolph counties. A part of the clay produced was sold in the crude state and the rest manufactured into fire-brick.

The pipe-clay deposits are more numerous than those of the fire-clay, and those worked in 1904 were in Guilford, Forsyth, Randolph, and Beaufort counties.

Production.

The total value of all fire-clay and pipe-clay production reported in 1904 was $114,200, this including fire-brick, fire-clay sold crude, sewer-pipe, tile, terra-cotta, etc. This is an increase of $7,086 in value as compared with $107,114, the value of the production of 1903. This in turn was an increase of $33,078 in value as compared with the value of the production of 1902, which was $74,036. This branch of the clay industry has been increasing rapidly during the past four or five years and illustrates what can be accomplished in the manufacture of the better grade of clay products. This, however, has been due principally to the progressiveness of the Pomona Terra-cotta Company at Pomona, Guilford County. This company's products are being shipped all over the State and to adjoining States.

Of this 1904 production, $2,700 was the value of 163,000 fire-brick, which were manufactured in Buncombe and Randolph counties. As compared with the manufacture of fire-brick in 1903, which numbered 407,500 brick, valued at $5,250, this is a decrease of 244,500 fire-brick in quantity and of $2,550 in value. There was a small amount of crude fire-clay sold in 1903, amounting to 80 tons, valued at $700.

The production of sewer-pipe, tile, terra-cotta, etc., during 1904, was from Guilford, Forsyth, Randolph, and Beaufort counties, and was valued at $110,800, as compared with a production valued at $100,989 in 1903. This is an increase in value of $9,811. Although there has been this continued increase from year to year in the value of the production of pipe-clay products, still the production does not begin to represent what this phase of the clay industry should amount to in North Carolina.

The following table, which gives the production of pipe-clay products for the past four years, shows the decided increase from year to year in the production of these products:

PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN NORTH CAROLINA, 1901-1904.

YEAR.	FIRE-BRICK.		SEWER-PIPE, TILE, ETC.	CRUDE CLAY.	
	QUANTITY.	VALUE.		TONS.	VALUE.
1901	55,000	$ 550	$ 55,745	------------	$ 100
1902	------------	1,203	72,618	------------	215
1903	407,500	5,250	100,989	231	875
1904	163,000	2,700	110,800	80	700

BRICK CLAY.

There are but few counties throughout North Carolina but contain clay deposits that are suitable for the manufacture of common brick, consisting of both residual and sedimentary clays. In a number of counties the clay is of such quality that it is capable of being used in the manufacture of pressed brick, front brick, or decorative brick. In order, however, to increase the manufacture of brick in the State and to make it a more profitable industry, it is absolutely essential that more attention be given to details in the manufacture of the brick (especially common brick), in order that a better and more homogeneous brick can be put on the market and one that is not only more attractive in appearance, but also capable of standing transportation and rough handling. Although there has been a decided increase from year to year during the past four years in the quantity and value of brick produced in the State, still this increase is not followed as rapidly as is warranted by the extensive building operations that have been going on throughout the State, and is due to the fact that in many of the buildings throughout the State a better quality of brick is desired and used than is produced in the State, and is consequently imported. The quality of the common brick produced in many of the counties is very inferior, but it is not the fault, in many cases, of the clay, but to the method of manufacture and incompetent employees. There has been but little attention paid to the manufacture of pressed, front, or fancy brick, although there are clays in the various parts of the State that are adapted to the manufacture of such brick, as those near Asheville, Buncombe County; Wilkesboro, Wilkes County; Goldsboro, Wayne County, etc. Many of these places are at the intersection of several lines of railroads, so that there would be good railroad facilities for shipment of the manufactured products. There have been used during the past year many million fancy, front, and pressed brick in North Carolina, of which less than 2,000,000 were manufactured in the State. It is almost impossible to obtain a first-class pressed brick in North Carolina, and when desired for use they have to be imported from South Carolina, Virginia, Maryland, and from other States.

One obstacle that has prevented the building up of the brick industry in the State is that the larger number of those engaged in this industry have little or no capital, so that they cannot install improved machinery, or take advantage of improved methods, and are compelled to employ incompetent laborers, with the result that the brick they put on the market is of a decidedly inferior quality. They are not able to burn more than one kiln at a time, and have to wait until this has been sold, or at least partly sold, before they are able to begin on another. The result is that during some parts of the year there is an excessive supply of brick on the market at a low figure and at other times during the year, especially in the late winter, there is scarcity of brick, and the price, even for the inferior grades, runs up to $8 to $9 a thousand. The manufacture of brick in North Carolina does offer safe and profitable investments, with a large and ready market for the manufactured good and at a good profit.

Production.

The total number of brick, with the exception of fire-brick, manufactured in North Carolina during 1904 amounted to 145,928,850, valued at $816,719. As compared with the production of 138,088,900 brick, valued at $745,032, in 1903, this is an increase of 7,839,950 brick in quantity and of $71,687 in value. The average value per thousand of the 1904 production of brick was $5.54, as compared with $5.39, the average value per thousand of the 1903 production, this being an increase of 15 cents per thousand. There were 57 counties from which this production was obtained, which is 5 less than in 1903, which in turn was 5 less than in 1902. Six counties—Anson, Ashe, Jackson, Martin, Sampson, and Stanly—which reported a production of brick during 1903, reported none in 1904; while Macon County, which made no production in 1903, became a producer in 1904. Of the 1904 production, there were 143,988,850 common brick, valued at $795,494, which is an increase of 7,165,950 brick in quantity and of $63,692 in value as compared with 136,822,900 common brick, valued at $731,802, the production of 1903. The number of pressed brick manufactured in 1904 was 1,510,000, valued at $17,375, and of vitrified brick 430,000, valued at $3,850, as compared with the production of 766,000 pressed brick, valued at $8,230, and 500,000 vitrified brick, valued at $5,000, in 1903. In the table below are given the quantity and value of common, pressed, vitrified and fire-brick produced in 1902, 1903, 1904:

PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND FIRE-BRICK IN 1902, 1903 AND 1904.

Character.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Common brick	131,618,700	$ 694,827	136,822,900	$ 731,802	143,988,850	$ 795,494
Pressed brick	1,833,000	10,625	766,000	8,230	1,510,000	17,375
Vitrified brick	600,000	6,000	500,000	5,000	430,000	3,850
Fire-brick	120,000	1,203	407,500	5,250	163,000	2,700
Total	134,171,700	712,655	138,496,400	750,282	146,091,850	819,419

The average value per thousand received for common brick in 1904 was $5.45, which is 11 cents greater than the average value of $5.34 per thousand of the 1903 production. The lowest value per thousand reported as having been received for common brick during 1904 was $2.25, which was received for 30,000 brick manufactured in Randolph County, and the highest value per thousand was $8.00, which was received for 100,000 brick from Beaufort, 300,000 from Washington, and 1,000 from Chatham counties. As a general rule, the brick manufactured in the extreme eastern counties bring a relatively higher average value than those manufactured in the other sections of the State, on account of the higher cost of the brick imported into these counties. The number of manufacturers engaged in making brick in 1904 was 179, which is 8 more than the number (171) engaged in this business in 1903, which was 24 less than the number (195) in 1902.

Although the number of manufacturers of brick was less in 1904 than in 1903, and the number of counties producing brick was less, yet the quantity and value of the production were greater, showing a relatively larger production from many of the producers in the State. There are some very extensive plants that are manufacturing a good quality of brick, using improved methods, etc., such establishments being located in the vicinity of Goldsboro, Wayne County; Greensboro, Guilford County; Charlotte, Mecklenburg County; Winston-Salem, Forsyth County; Wilmington, New Hanover County, etc.

There is given in the following tables the total number and value of the different varieties of brick, including fire-brick, manufactured in North Carolina during 1903 and 1904 by counties:

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1904, BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE-BRICK.	VALUE.
Alamance	4,440,000	$ 25,750	----------	$------	----------	$------
Beaufort	2,840,000	17,000	----------	------	30,000*	300
Bertie	1,475,000	8,850	----------	------	----------	------
Bladen	300,000	1,800	----------	------	----------	------
Buncombe	3,575,000	18,860	100,000	1,250	153,000†	2,600
Burke	550,000	2,800	----------	------	----------	------
Cabarrus	5,350,000	26,750	100,000	1,000	----------	------
Caldwell	2,200,000	8,800	----------	------	----------	------
Carteret	341,000	1,850	----------	------	----------	------
Catawba	1,960,000	10,045	----------	------	----------	------
Chatham	151,000	708	----------	------	----------	------
Chowan	1,000,000	7,000	----------	------	----------	------
Cleveland	915,000	4,800	----------	------	----------	------
Columbus	2,000,000	10,300	----------	------	----------	------
Craven	8,639,000	47,515	----------	------	----------	------
Cumberland	1,750,000	9,500	----------	------	----------	------
Davidson	1,075,000	5,300	5,000	75	----------	------
Duplin	26,000	174	----------	------	----------	------
Durham	3,665,000	19,625	----------	------	----------	------
Edgecombe	6,075,000	36,200	----------	------	----------	------
Forsyth	5,380,000	28,540	----------	------	----------	------
Gaston	3,500,000	19,400	----------	------	----------	------
Gates	90,000	270	----------	------	----------	------
Greene	60,000	420	----------	------	----------	------
Guilford	13,450,000	78,368	50,000	500	100,000*	850
Halifax	4,100,000	24,000	125,000	1,250	----------	------
Harnett	250,000	1,450	----------	------	----------	------
Haywood	800,000	4,400	----------	------	----------	------
Henderson	2,000,000	10,000	30,000	300	300,000*	2,700
Iredell	995,000	5,250	----------	------	----------	------
Johnston	2,840,000	15,800	----------	------	----------	------
Lenoir	500,000	2,000	----------	------	----------	------
Lincoln	1,225,000	6,300	----------	------	----------	------
McDowell	450,000	2,700	200,000	2,000	----------	------
Macon	150,000	750	----------	------	----------	------
Mecklenburg	3,500,000	21,000	----------	------	----------	------
Montgomery	10,000	40	----------	------	----------	------
Moore	2,900,000	16,400	----------	------	----------	------
Nash	1,300,000	7,800	----------	------	----------	------
New Hanover	2,750,000	17,125	800,000	10,000	----------	------
Orange	1,217,000	6,628	----------	------	----------	------
Pasquotank	1,900,000	10,800	----------	------	----------	------
Pitt	2,200,000	13,200	----------	------	----------	------
Randolph	990,000	5,266	----------	------	10,000†	100
Robeson	1,805,000	10,788	----------	------	----------	------
Rockingham	7,580,000	38,075	100,000	1,000	----------	------
Rowan	4,100,000	23,000	----------	------	----------	------
Rutherford	1,000,000	5,700	----------	------	----------	------
Scotland	500,000	3,000	----------	------	----------	------
Surry	1,325,000	6,375	----------	------	----------	------
Transylvania	125,000	750	----------	------	----------	------
Union	4,879,000	24,768	----------	------	----------	------
Wake	5,717,850	31,479	----------	------	----------	------
Washington	300,000	2,400	----------	------	----------	------
Wayne	9,000,000	49,625	----------	------	----------	------
Wilkes	1,500,000	7,500	----------	------	----------	------
Wilson	5,273,000	30,500	----------	------	----------	------
Total	143,988,850	795,494	1,510,000	17,375	593,000	6,550

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*Vitrified brick.

†Fire-brick.

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1903 BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE-BRICK.	VALUE.
Alamance	2,750,000	$ 15,250	------	$------	------	$------
Anson	1,000,000	5,500	------	------	------	------
Ashe	300,000	1,500	------	------	------	------
Beaufort	1,323,000	8,200	------	------	------	------
Bertie	4,600,000	21,000	------	------	------	------
Bladen	200,000	1,100	------	------	------	------
Buncombe	4,305,900	22,686	150,000	2,250	365,500*	5,100
Burke	400,000	1,600	------	------	------	------
Cabarrus	5,010,000	25,055	100,000	1,000	------	------
Caldwell	1,500,000	5,250	------	------	------	------
Carteret	150,000	900	------	------	------	------
Catawba	1,920,000	9,680	------	------	------	------
Chatham	------	------	------	------	2,000†	20
Chowan	1,000,000	7,000	------	------	------	------
Cleveland	975,000	5,320	200,000	2,000	------	------
Columbus	2,000,000	10,000	------	------	------	------
Craven	6,000,000	47,750	------	------	------	------
Cumberland	1,750,000	9,500	------	------	------	------
Davidson	500,000	2,500	------	------	------	------
Duplin	50,000	278	------	------	------	------
Durham	6,710,000	36,210	------	------	------	------
Edgecombe	5,450,000	32,700	------	------	------	------
Forsyth	8,505,000	44,625	150,000	1,500	------	------
Gaston	2,670,000	14,350	------	------	------	------
Gates	105,000	375	------	------	------	------
Greene	635,000	4,445	------	------	------	------
Guilford	8,188,000	44,817	------	------	------	------
Halifax	3,400,000	19,500	70,000	600	------	------
Harnett	2,500,000	10,800	------	------	------	------
Haywood	700,000	3,990	------	------	------	------
Henderson	1,000,000	5,000	------	------	500,000*	5,000
Iredell	3,200,000	15,900	------	------	------	------
Jackson	70,000	420	------	------	------	------
Johnston	1,730,000	10,350	------	------	------	------
Lenoir	1,000,000	6,500	------	------	------	------
Lincoln	830,000	4,150	------	------	------	------
McDowell	2,900,000	14,500	------	------	------	------
Martin	8,000	48	------	------	------	------
Mecklenburg	2,300,000	14,000	------	------	------	------
Montgomery	282,000	1,403	------	------	------	------
Moore	2,682,000	13,687	------	------	------	------
Nash	1,000,000	5,500	------	------	------	------
New Hanover	2,750,000	16,500	------	------	------	------
Orange	1,000,000	4,950	------	------	30,000†	30
Pasquotank	1,800,000	10,800	------	------	------	------
Pitt	1,240,000	7,458	------	------	------	------
Randolph	780,000	3,742	------	------	10,000†	100
Robeson	352,000	2,103	14,000	124	------	------
Rockingham	3,216,000	18,860	------	------	------	------
Rowan	2,500,000	13,500	------	------	------	------
Rutherford	650,000	3,340	------	------	------	------
Sampson	50,000	250	------	------	------	------
Scotland	600,000	3,300	------	------	------	------
Stanly	300,000	1,200	------	------	------	------
Surry	1,210,000	5,755	50,000	500	------	------
Transylvania	95,000	500	------	------	------	------
Union	3,437,000	15,555	------	------	------	------
Wake	5,166,000	26,095	------	------	------	------
Washington	30,000	240	------	------	------	------
Wayne	9,150,000	51,075	------	------	------	------
Wilkes	1,598,000	7,990	32,000	256	------	------
Wilson	6,300,000	35,250	------	------	------	------
Total	136,822,900	731,802	766,000	8,230	907,500	10,250

*Vitrified brick.

†Fire-brick.

Of the 97 counties in North Carolina, only 57 reported any production of brick. The County producing the largest number of brick in 1904 was Guilford, whose production was 13,450,000, valued at $78,368. Wayne was second with a production of 9,000,000, valued at $49,625, and Rockingham third with a production of 7,580,000, valued at $38,075. In 1903 Wayne County was first in its production of brick, Forsyth County second, and Guilford County third, with the following productions respectively: 9,150,000, valued at $51,075; 8,655,000, valued at $46,125; and 8,188,000, valued at $44,817. The county producing the smallest number of brick was Montgomery, which reported a production of only 10,000 brick, valued at $40. In 1903 Martin County was the smallest producer, with 8,000 brick, valued at $48.

There is given in the table below the quantity and value of all the clay products produced in North Carolina in 1901, 1902, 1903, and 1904:

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN 1901, 1902, 1903, AND 1904.

	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
mmon brick	134,441,570	$ 697,861	131,611,700	$ 694,827	136,822,900	$ 731,802	143,988,850	$ 795.494
essed brick	1,095,000	10,220	1,233,000	10,625	766,000	8,230	1,510,000	17,375
trified brick	180,000	1,650	600,000	6,000	500,000	5,000	430,000	3,850
e-brick	55,000	550	------	1,203	407,500	5,250	163,000	2,700
rthenware	------	4,490	------	658	------	612	------	438
oneware	------	17,453	------	13,854	------	13,700	------	13,462
corated ware	------	552	------	------	------	------	------	------
wer-pipe, tile, tc.	------	55,745	------	72,618	------	100,989	------	110,800
	Tons.		Tons.		Tons.		Tons.	
olin	15,575	119,172	13,322	108,105	8,605	76,000	9,110	76,670
e-clay	------	100	------	215	231	875	202*	761
Total value	------	907,793	------	908,105	------	942,458	------	1,021,550

*Including ordinary stoneware clay sold rough.

The above statistics regarding the clay production of the State do not, perhaps, represent the output in its entirety for the reason that in many of the counties there are a few thousand brick occasionally made for local purposes regarding which it is difficult or impossible to obtain any statistics, this being especially true where the bricks are not for sale, but are used directly by those making them.

In the following table there is given the values of the various minerals produced in North Carolina for the years 1900 to 1904, inclusive, and shows at a glance the variations in the production of the different minerals, and also shows up concisely those minerals which have made a constant increase in their productions since 1900:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1900, 1901, 1902, 1903, AND 1904.

MINERAL.	VALUE.				
	1900.	1901.	1902.	1903.	1904.
Gold	$ 46, 653	$ 60, 411	$ 93, 650	$ 113, 604	$ 123, 924
Silver	15, 986	34, 024	30, 212	16, 907	19, 132
Copper	41, 600	76, 900	212, 553	67, 037	36, 600
Iron	42, 000	4, 997	52, 771	78, 540	79, 846
Pyrite	14, 625	32, 000	----------	----------	----------
Garnet	18, 000	43, 000	10, 040	12, 250	6, 586
Corundum	36, 840	48, 840	----------		
Millstones	----------	----------	1, 425	902	6, 500
Mica, Sheet	65, 200	79, 849	81, 653	86, 300	100, 724
Mica, Scrap	36, 262	14, 200	2, 919	2, 400	3, 410
Quartz	----------	7, 500	11, 250	36, 827	36, 269
Precious stones	12, 020	24, 245	5, 300	1, 525	10, 600
Rare minerals	----------	----------	60	270	160
Monazite	48, 805	59, 262	64, 160	58, 694	79, 438
Zircon	----------	----------	360	570	200
Barytes	----------	22, 615	44, 130	21, 347	33, 930
Talc and pyrophyllite	42,000	77,974	88, 962	76, 984	65, 483
Graphite	----------	559	4, 300	248	525
Coal	22, 500	5, 585	24, 500	25, 300	8, 820
Stone	285, 172	284, 744	366, 727	360, 322	312, 576
Kaolin	62, 440	119, 172	108, 105	76, 000	76, 670
Clay products	815, 975	788, 618	800, 000	866, 458	944, 880
Total value	1, 604, 078	1, 779, 109	2, 003, 077	1, 902, 485	1, 946, 273

As is seen from the above table, the total value of $1,946,273 is somewhat greater than the total value of $1,902,485 of the 1903 production, this increase amounting to $43,788. This production was obtained from 76 counties out of the 97 in the State, and in the following table the value of the production for the years 1903 and 1904 in each county is given. The value of the clay products, with the exception of kaolin, which is included with "other minerals," is given separately from the rest of the mineral production.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1903 AND 1904.

COUNTY.	1903.			1904.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, IECLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Alamance	$----------	$ 15,250	$ 15,250	$ 24	$25,750	$ 25,774
Alexander	50	----------	50	150	----------	150
Alleghany	----------	----------	----------	----------	----------	----------
Anson	600	5,500	6,100	304	----------	304
Ashe	1,000	1,500	2,500	175	----------	175
Beaufort	----------	8,200	8,200	----------	17,500	17,500
Bertie	----------	21,300	21,300	----------	8,850	8,850
Bladen	----------	1,100	1,100	----------	1,800	1,800
Brunswick	----------	----------	----------	----------	----------	----------
Buncombe	14,566	32,371	46,957	24,728	23,471	48,199
Burke	12,629	1,600	14,229	26,806	2,800	29,606
Cabarrus	3,323	26,055	29,378	15,083	27,750	42,833
Caldwell	42	5,250	5,292	10,047	8,800	18,847
Camden	----------	----------	----------	----------	----------	----------
Carteret	----------	900	900	----------	1,850	1,850
Caswell	----------	----------	----------	----------	----------	----------
Catawba	7,060	12,835	19,895	5,544	14,520	20,064
Chatham	27,523	2,000	29,523	8,918	1,308	10,226
Cherokee	50,116	----------	50,116	45,211	----------	45,211
Chowan	----------	7,020	7,020	----------	7,000	7,000
Clay	297	----------	297	2,458	----------	2,458
Cleveland	19,969	7,320	27,289	32,682	4,800	37,482
Columbus	----------	10,000	10,000	----------	10,300	10,300
Craven	----------	47,750	47,750	----------	47,515	47,515
Cumberland	----------	9,500	9,500	----------	9,500	9,500
Currituck	----------	----------	----------	----------	----------	----------
Dare	----------	----------	----------	----------	----------	----------
Davidson	672	2,500	3,172	1,694	5,375	7,069
Davie	----------	----------	----------	----------	----------	----------
Duplin	----------	278	278	----------	174	174
Durham	----------	36,210	36,210	----------	19,625	19,625
Edgecombe	----------	32,700	32,700	----------	36,200	36,200
Forsyth	----------	46,401	46,401	----------	28,840	28,840
Franklin	165	----------	165	90	----------	90
Gaston	1,112	14,350	15,462	1,111	19,400	20,511
Gates	----------	375	375	----------	270	270
Graham	----------	----------	----------	----------	----------	----------
Granville	5,477	----------	5,477	1,799	----------	1,799
Greene	----------	4,445	4,445	----------	420	420
Guilford	3,966	144,817	148,783	12,899	189,718	202,617
Halifax	426	20,100	20,526	180	25,250	25,430
Harnett	----------	10,800	10,800	----------	1,450	1,450
Haywood	18,560	3,990	22,550	36,500	4,400	40,900
Henderson	17,589	10,800	28,389	11,295	13,000	24,295
Hertford	----------	----------	----------	----------	----------	----------
Hyde	----------	----------	----------	----------	----------	----------
Iredell	160	15,900	16,060	240	5,250	5,490
Jackson	94,646	420	95,066	76,854	----------	76,854
Johnston	15,000	10,685	25,685	----------	16,150	16,150
Jones	----------	----------	----------	----------	----------	----------

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1903 AND 1904—*Continued.*

COUNTY.	1903.			1904.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Lenoir	$------	$ 6,500	$ 6,500	$------	$ 2,000	$ 2,000
Lincoln	15,256	7,520	22,776	1,841	10,270	12,111
McDowell	34,690	14,500	49,190	27,190	4,700	31,890
Macon	3,749	------	3,749	47	750	797
Madison	26,447	------	26,447	37,986	------	37,986
Martin	------	48	48	------	------	------
Mecklenburg	8,682	14,000	22,682	1,183	21,000	22,183
Mitchell	93,127	------	93,127	109,466	------	109,466
Montgomery	49,513	1,403	50,916	51,362	390	51,752
Moore	7,769	13,687	21,456	5,860	16,400	22,260
Nash	142	5,500	5,642	45	7,800	7,845
New Hanover	20,400	16,500	36,900	12,346	27,125	39,471
Northampton	------	------	------	------	------	------
Onslow	------	------	------	------	------	------
Orange	27,781	4,980	32,761	10,617	6,628	17,245
Pamlico	------	------	------	------	------	------
Pasquotank	------	10,800	10,800	------	10,800	10,800
Pender	600	------	600	------	------	------
Perquimans	------	------	------	------	------	------
Person	71,316	------	71,316	15,506	------	15,506
Pitt	------	7,458	7,458	------	13,200	13,200
Polk	7,507	------	7,507	13,738	------	13,738
Randolph	403	5,797	6.200	26,236	6,481	32,717
Richmond	------	------	------	770	------	770
Robeson	------	2,227	2,227	------	10,788	10,788
Rockingham	10,200	18,860	29,060	------	39,075	39,075
Rowan	112,573	13,500	125,073	127,774	23,000	150,774
Rutherford	12,344	3,340	15,680	5,904	5,700	11,604
Sampson	------	250	250	------	------	------
Scotland	------	3,300	3,300	------	3,000	3,000
Stanly	24,640	1,200	25,840	17,271	------	17,271
Stokes	7,740	------	7,740	------	------	------
Surry	111,462	6,255	117,717	110,466	6,375	116,841
Swain	53,150	------	53,150	57,258	------	57,258
Transylvania	516	500	1,016	------	750	750
Tyrrell	------	------	------	------	------	------
Union	3,198	16,055	19,253	9,902	25,168	35,070
Vance	14,750	------	14,750	8,000	------	8,000
Wake	248	26,095	26,343	525	31,479	32,004
Warren	751	------	751	361	------	361
Washington	------	240	240	------	2,400	2,400
Watauga	------	------	------	------	------	------
Wayne	------	51,075	51,075	------	49,625	49,625
Wilkes	------	9,396	9,396	------	8,694	8,694
Wilson	------	35,250	35,250	------	30,500	30,500
Yadkin	------	------	------	------	------	------
Yancey	20,600	------	20,600	35,300	------	35,300
Unknown	1,525	------	1,525	1,047	------	1,047
Total value	866,458	1,036,027	1,902,485	1,001,393	944,880	1,946,273

As is seen from the above table, the following counties reported no production of mineral of any kind during 1904: Alleghany, Brunswick, Camden, Caswell, Currituck, Dare, Davie, Graham, Hertford, Hyde, Jones, Martin, Northampton, Onslow, Pamlico, Pender, Perquimans, Sampson, Stokes, Tyrrell, Watauga, and Yadkin. Of these counties the following reported a production in 1903: Martin, Pender, Sampson, and Stokes. There was only one county which made a production in 1904 that did not produce in 1903, and that was Richmond.

Of the 76 counties reporting a mineral production for 1904, there were only 48 counties that reported anything besides clay products. There were 57 counties reporting a production of clay, of which 27 counties did not report any other production. There were 14 counties reporting a mineral production which did not include any clay products. The number of counties producing both clay and other mineral products was 74. The county reporting the greatest value for its mineral production, excepting clay products, was Rowan County, the value being $127,774. The county producing the greatest value of clay products was Guilford, the value being $189,718. The county whose total mineral production was greatest in value in 1904 was Guilford County, the value being $202,617. Rowan County is second in the value of its total mineral production, which was valued at $150,774. The lowest value reported by any county for its mineral production was Alexander County, with a value of $150.

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BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

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THE NORTH CAROLINA GEOLOGICAL SURVEY.

JOSEPH HYDE PRATT, ACTING STATE GEOLOGIST.

Economic Paper No. 10.

OYSTER CULTURE
IN
NORTH CAROLINA

BY

ROBERT E. COKER.

MAY 20 1775

RALEIGH:
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LETTER OF TRANSMITTAL.

RALEIGH, N. C., December 1, 1905.

To His Excellency, HON. ROBERT B. GLENN,
Governor of North Carolina.

SIR:—I have the honor to submit for publication, as the tenth of the series of Economic Papers, a special report on Oyster Culture in North Carolina. In connection with the development of our oyster industry there are certain questions that are constantly being raised, and an attempt has been made to answer these in this paper.

Yours obediently,
JOSEPH HYDE PRATT,
Acting State Geologist.

OYSTER CULTURE IN NORTH CAROLINA.*

By Robert E. Coker.

INTRODUCTION.

In connection with the experimental work of the Fisheries Laboratory established at Beaufort, Carteret County, North Carolina, investigations have been conducted by the North Carolina Geological Survey in conjunction with the United States Bureau of Fisheries relative to the possibilities of oyster culture in North Carolina waters. From the first many courtesies were extended by Mr. W. M. Webb, State Oyster Commissioner, and in the present year (1905) the Oyster Commission has entered into coöperation with the Bureau and the Survey in continuing the experiments. These investigations have extended over a period of years, and at first were carried on near Beaufort in Newport and North rivers; but, owing to the success that was attained at these points, it was deemed advisable to try larger plants and a greater variety of bottoms, and for this purpose there was chosen the large and varied field offered by Pamlico Sound. In order to ascertain by actual trial what methods best suited particular regions or bottoms, plants were made on different bottoms and in various localities. By visits at intervals of a few months these experimental beds have been kept under observation, and data have been accumulated regarding the set of "spat," rate of growth, and other biological and physical conditions. Such investigations, however, did not seem entirely adequate for the needs of the case, and, therefore, in order to gain as practical a view of the situation as possible, and in order to profit by all experiments of whatever nature and by whomsoever made, the work has been supplemented by obtaining the results and experience of those who have actually planted with a view to financial profit.

It is not within the scope of the present paper to treat the direct results of the experiments and field observations, but rather to present certain observations and considerations which seem necessary to a proper understanding of the situation in regard to oyster culture.

It was intended that this paper should be in print by January, 1905, and ready for distribution at the convening of the Legislature, but owing to unavoidable circumstances its publication was delayed.

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*Prepared in co-operation with the U. S. Bureau of Fisheries and published with the consent of Hon. George M. Bowers, U. S. Commissioner of Fish and Fisheries. The Commissioner is not, however, responsible for any of the views expressed herein.

It was practicable only to bring the manuscript to the attention of some of the members of the legislative committees concerned with the matter of legislation relating to the oyster industry. The acts of the Legislature of 1905 in respect to the leasing of bottoms for the cultivation of the oyster made such an improvement in the situation as seemed to require a thorough revision of the report. When, however, the full purpose of the paper is considered—the intention to give the people of the State some acquaintance with the condition of the industry of oyster cultivation and with some of the reasons for its want of development—it is thought best to present the paper essentially as originally prepared.

The laws relating to the leasing of bottoms, as enacted by the Legislature of 1905, are given on page 20.

OBJECTS OF THE INVESTIGATIONS.

It has been the aim of the investigation to answer by experiment and personal inquiry the following questions:

1. Can oysters be profitably cultivated in North Carolina waters?
2. Is oyster cultivation now an industry of any importance in North Carolina?
3. Can the State by investigation or legislation encourage the development of this industry?

1. Can oysters be profitably cultivated in North Carolina waters?

When we consider the abundance of the yield of the natural oysters and the very fine quality of the oysters of many places such as Harbor Island, Far Creek, Judith's Island, and New River, or if we regard the demand for North Carolina oysters in wholesale markets of Norfolk and other points, we find strong evidence in favor of an affirmative answer to the first question. The results that have been obtained in the experimental work in Newport River, which are described in the report of Dr. Grave,* are in accord with the verdict given above, as is also the general opinion of planters who have taken up the cultivation of oysters from a financial standpoint. Of all the planters who have been interviewed, there is but one who did not speak encouragingly in reference to this question.

2. Is oyster cultivation now an industry of any importance in North Carolina?

At the present time this question would have to be answered negatively. At some points it was learned that there were many holdings, and at others that there had been, but that the claims had been

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*Bulletin N. C. Geological Survey. In press.

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practically relinquished. Careful inquiries have been made at a number of points from Beaufort to Roanoke Island, but at no place was it found that the quantity of oysters planted per year or the amount marketed from private grounds was, from an economic point of view, worthy of consideration. One planter holds ten acres of bottom on which he annually plants, by estimate, 200 bushels of oysters, or not half the quantity that might safely be planted annually on one acre. Another planter uses 30 acres, held by himself and two other members of his family, and plants about 300 bushels of oysters one year, but plants none the next year. Still another planter had, formerly, still larger holdings, held through subleases, on which he at one time made very extensive plantings; but since it was found impracticable to protect his oysters, or for some other reason, he has not for a number of years planted or marketed to any extent. The same stories, slightly varied, are heard again and again. But the fact should not be overlooked that at several points throughout the oyster district there are a few oystermen who annually make their small plants, and by this means not only do they add appreciably to their own income, but, better, they are demonstrating that the cultivation of the oyster is a feasible and profitable undertaking. There is, however, no community in North Carolina in which the industry is of such importance that, were all planting to stop abruptly, the fortunes of the community would be seriously damaged; and this refers to an industry which, in other States, yields a product valued at hundreds of thousands of dollars. No reason is found for believing that the cultivation of the oyster may not be profitable in the waters of North Carolina. The growth of oysters in this State is more rapid than in more northerly States and the conditions for seed production are more favorable. During the past few years, when Virginia planters have been in serious need of seed, when in Connecticut the oyster industry has been seriously menaced by dearth of spat,* the North Carolina waters have shown each year a satisfactory set.

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* "A year ago it was the hope of the commissioners that the three years of partial and unsatisfactory set would be succeeded in 1903 by a full set which would re-seed the public grounds and restock Connecticut waters, but this has not been the case. The failure of the natural oyster beds of Connecticut in 1903 was more general and discouraging than that of the three years next preceding. * * * What a difference four poor years may make to the planters can be readily imagined, and to the worker on the natural ground it is simply destruction." (Report of the Shell-fish Commission of the State of Connecticut, 1903, pp. 11 and 12).

"There has been no general set in New York waters since the year 1899. The abundance of that year has ever since furnished the trade with market stock and will carry the dealers over another year, during which, however, higher prices may be looked for. Should the next season not prove more bountiful in this particular, the planters will be in dire straits." (Ninth Annual Report of the Forest, Fish and Game Commission of the State of New York, transmitted to the Legislature, Jan. 18, 1904, p. 102).

"For the last two years there has been no oyster set, not only in our waters, but in waters adjoining us. As a very large supply of seed oysters which are planted in our State are produced in our neighboring State of Connecticut, we make the following extract from the last annual report of the Shell-fish Commissioners of that State as to sets there." (Then follows a quotation including the extract used above). (Annual Report of the Commissioners of Shell Fisheries made to the General Assembly (of the State of Rhode Island or Providence Plantations) at its January session, 1904).

3. Can the State by investigation or legislation encourage the development of this industry?

As has been suggested in the answer given to the first question, the undeveloped condition of oyster culture in North Carolina is not to be attributed chiefly to natural conditions; and the investigations that have been carried on during the past few years encourage the belief that oyster culture can be made a profitable industry, if the legislative conditions governing the leasing of the bottoms can be changed so as to give the planter an incontestable title to the bottoms upon which he is making his plants. The physical and biological conditions are treated in detail in Dr. Grave's report and will not, therefore, be discussed here; but consideration will be given principally to the legislative conditions governing oyster culture.

Some of the conditions that have persistently and insistently presented themselves as provisions necessary for the development of oyster culture in North Carolina are taken up in detail under the following heads:

1. An incontestable title.
2. Protection of the natural rocks.
3. Protection of the natural clam beds.
4. The liberty of lessee as regards methods and seed culture.
5. Maximum area.
6. The annual rent of bottoms.
7. The reversion of bottoms to the State.
8. Term of lease.

I. AN INCONTESTABLE TITLE.

The most essential condition relating to the development of oyster cultivation in North Carolina waters is that *the title of the lessee to bottoms for oyster culture shall be incontestable for the period of time for which the lease is granted, unless forfeited by the failure of the lessee to fulfill his part of the contract.* Some have, in good faith, entered bottoms for oyster culture with full conformity to the law and have invested their time and money in planting on these bottoms, only to have their title destroyed as soon as the beds became productive; as a consequence, yet without fault on their part, they suffered serious losses. These people cannot be expected to reinvest their time and money in oyster cultivation or to give any encouragement to others to attempt the same thing. Our present laws were intended to give an incontestable title to the lessee and at the same time to protect the State from any fraud; but these laws did not fulfill what was expected of them, as is evident from the results of the cases in court in which has been questioned the validity of the lease to certain productive planted grounds.

From a perusal of the sections of the North Carolina Code relating to oyster cultivation, it is seen that the entry of bottoms is permitted, provided they do not include natural rocks. This is of course a wise provision. But what means are provided for ascertaining, before granting the lease, whether or not the particular bottom in question is a natural rock? The grant is issued and the question of natural rock remains unanswered until perhaps several years later, when a trespasser is being prosecuted, he defends his act by denying the validity of the lessee's title, or claiming that the bottom in question is a *natural rock,* and a number of witnesses are introduced to prove in court that when the ground was entered by the lessee several years before, there was such and such a quantity of oysters on that particular bottom, sufficient, say, for an ordinary oysterman to earn a daily wage.* Whether or not the lessee intended to deal in good faith, his holdings and all his labor may be lost in a moment. It is thus very important that the question, whether a bottom is a natural rock or not, should be definitely and finally settled before the lease is made. The people would not then be deprived for a period of time of the uses of productive oyster bottoms which rightfully belong to the public; nor, on the other hand, would the investor be liable to throw away his labor and capital on bottoms which he cannot control.

For some years there has been in court a case of the State against a private planter, of Hyde County, for the recovery of oyster bottoms which were granted to the planter by the State, but which, it is now maintained, could not have been taken up legally, because it can be shown by witnesses that the bottoms in question were, at the time they were entered, natural beds. In the meantime, however, thousands of dollars had been spent by the lessee in planting and protecting his holdings. Assuming that the planter was sincere in declaring the bottoms he desired to enter were not natural oyster beds, he is yet forced to defend his title in a long and expensive lawsuit, which will result either in showing that the suit is unfounded or in depriving him of large investments that he has made in good faith. On the other hand, however, assuming that his original declaration was insincere, the public has for a period of years been fraudulently deprived of the use of the natural oyster bottoms in question, and for the recovery of these bottoms the State is forced to great expense. All such trouble and wasteful litigation may be prevented in future by the State ascertaining *before a lease is granted* whether or not the particular bottom or bottoms in question are natural oyster rocks; so that the lease, once granted, will be incontestable so far as relates to the question whether or not the original bottoms were natural oyster rocks. Thus, in the case referred to above, if the bottoms were natural oyster bottoms, the lease should never have been granted, whatever might have been the declaration of the interested party; and, on the other hand, if the bottoms were properly subject to lease, the lessee should not at any time, because of uncertainty as to the original conditions of the bottoms in question, have his title threatened or be put to great expense to prove the propriety of his possession. Proper protection to the State from improper entry will at the same time be a protection to the lessee who has made the entry.

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* Illustrative law case regarding title to oyster bottoms:

THE STATE v. ELIJAH D. WILLIS (104 North Carolina, p. 764).

"This was a criminal action tried on appeal from the Justice of the Peace before *Shipp, J.,* at Spring Term, 1899, of CARTERET Superior Court." The defendant was charged "with taking oysters from the oyster gardens of one John D. Chadwick, on or about 20th day of February, 1888, without permission of said Chadwick first had." The defendant pleaded "Not guilty," contending that the said bed staked off and enclosed was a "natural oyster bed" and "any citizen had a right to take oysters therefrom." * * * "The jury returned the following special verdict:

"That the prosecutor, John D. Chadwick, has had his oyster garden made and staked out in Carteret County according to the requirements of the statute, and obtained a license, or grant, from the Clerk of the Superior Court of Catawba County for the same; that the defendant took oysters therefrom, within the stake so laid off, without permission of John D. Chadwick first had; that there were no oyster rocks within the stakes where the garden was so laid off; that there were some oysters within the same, but that they were scattering, and oysters naturally grew there; that the area embraced within the stakes, which was two and three-fourths acres, was not such as would within itself induce the public to resort to it and get oysters, but in connection with the oyster rocks and oysters nearby, the public were in the habit of taking oysters from the said area and adjacent territory for livelihood or for market.

"If upon the foregoing statement of fact the Court be of the opinion that the defendant is guilty, then the jury say he is guilty; but if upon said statement the Court is of opinion that defendant is not guilty, then the jury finds he is not guilty.

"Whereupon, the Court adjudged that the defendant is not guilty."

In the case instanced the decision of the Superior Court Judge was afterwards reversed by the Supreme Court on the ground that the verdict of the jury, by not bringing the case within the definition of a natural rock, did not authorize a verdict of "not guilty." But in other instances, the history of the cases has been different and more disastrous for the planter.

The question is particularly complicated because the term "natural rock" cannot of necessity be an exact term. One person, in good faith, will affirm that a bottom in question is a natural rock, while another, also in good faith, will affirm that it is not a natural rock, because they differ in their ideas as to the degree of abundance of oysters that is required to form a technical "natural rock." Again a witness may dishonestly affirm or deny that a given bottom was a natural rock. Of course, personal statements regarding a previous condition of a bottom are practically impossible of verification. If oyster planting is to be encouraged in North Carolina, too many barriers must not be placed in the way of entry and investment, although it were far better to have almost insurmountable barriers than to permit an investor to enter and build up a business on an entry which, instead of being a solid foundation, may prove to be a delusion. Incontestability of title, as long as the lessee fulfills his part of the contract, is a prerequisite of a prosperous oyster-planting industry.

HOW MAY EXISTING CONDITIONS BE REMEDIED?

One satisfactory solution of this question is a complete survey of the oyster bottoms, which, by means of charts, stakes and buoys, will render it easy to ascertain what grounds are closed and what are open to entry. This method has in Virginia formed the backbone of an industry which has enriched persons and communities and added largely, both directly and indirectly, to the revenues of the State. Although such a survey calls for a considerable outlay on the part of the State at one time, yet as it would be the most satisfactory, it is believed that the State would be justified in making the expenditure that the survey would entail.

A more economical method than the above would be as follows: The bottoms to be entered should be personally examined by an officer or officers appointed or elected with the duty and power of determining positively whether the bottoms in question are or are not natural rocks. When a bottom is applied for, the application and the date set for examination and hearing of objections should be duly advertised, and full opportunity given for those who desire to do so to present objections to the granting of the lease. The official verdict, when rendered, should be final.

It is clearly important that this duty of the examination of oyster bottoms should be assigned to some officer or officers who have more than a casual acquaintance with oyster bottoms and oyster cultivation. It might properly be assigned to the Oyster Commissioner and his assistants, or to responsible boards in the several counties appointed or elected for the purpose. If delegated to the Oyster Commission, such duties would doubtless be taken up chiefly during the closed season (April 1 to September 30, inclusive), thus making a greater demand upon the time of the Commissioner. If the duty of examination pertained to a county board, the members should be allowed a fixed compensation and reimbursement for necessary expenses. The services of an official (State or county) surveyor would be required. All fees and expenses should be paid by the applicant, and in consideration of this expense the rental for the first year of the lease might be remitted.

II. PROTECTION OF THE NATURAL ROCKS.

"A 'natural oyster bed,' as distinguished from an 'artificial oyster bed,' in the sense in which those terms are employed in The Code, is defined to be 'one not planted by man, and is any shoal, reef or bottom where oysters are to be found growing, not sparsely or at intervals, but in a mass or stratum in sufficient quantities to be valuable to the public.' " (Sec. 2371 North Carolina Code, page 701). Briefly, a *"natural bed" or "natural rock" is a bottom whereon oysters occur naturally and in sufficient abundance for an ordinary oysterman to make a daily wage.* Grounds where oysters are found more scatteringly are not to be considered as "natural rocks" or "beds."

Probably if no restriction whatever were made and all bottoms were thrown open for entry, the final result might be quite advantageous, and we would have in the end wonderfully productive bottoms which would give employment to thousands of oystermen and yield large revenues both to the planters and to the State. The objection to such a procedure is that in the meantime thousands of oystermen, who are now accustomed to earning their winter's living from the public oyster grounds, would be temporarily thrown out of employment. Then again, most of the fertile public bottoms would fall into the hands of a few, who would not be able to improve them so that their yield would be greatly increased. As a consequence, much harm and suffering would result in the readjustment to these new conditions. It must, therefore, be accepted that the natural rocks shall be left open to the public.

However definite a law may be regarding the delimitation of the natural rocks or beds, a great deal, of necessity, will have to be left to the judgment and discretion of the officials appointed for this work. Thus, in a given bay there may be many small patches of oysters scattered here and there, the oysters being abundant in each little patch; but the beds taken collectively cover but a very small area of the bay. The question at once arises, shall the whole bay be closed to entry, or shall each small bed be plotted off as closed ground and the rest left open for entry, or shall the whole bay be left open? The officer's decision must depend largely on the abundance and size of the patches. A search of the laws of other states shows no attempt to lay down a more definite rule, nor can any be suggested. In rendering the decision from which the above definition was quoted, Justice Shepherd said: "While it seems impossible to give a more particular definition, it is believed that the one that we have adopted reflects the true spirit of the law and may be of some practical use in ascertaining where grants may be made." With that definition and by the use of careful judgment, the officer need make no serious mistake. In this connection the following suggestions for working rules may be given:

a. In general, the benefit of the doubt should be given to the natural rock; as the least friction and trouble for all parties concerned will result from an error of keeping closed certain grounds that might have been left open, than from the mistake of leaving open grounds that should properly be closed.

b. A small area should be left around each natural bed and straight lines should be used in bounding them. This will save trouble to the oysterman working on public grounds, annoyance to the planter, and needless litigation on account of trespassing. The planter would find it difficult to protect his oyster bottoms from malicious or unintentional marauders if his ground was separated from the natural beds by irregular lines.

III. PROTECTION OF NATURAL CLAM BEDS.

In what has been said so far, no reference has been made to the matter of natural clam bottoms. The interest of the clammer is no less worthy of consideration on the part of the State than is that of the oysterman. The hard clam or "little-neck" clam (*Venus mercenaria*) is the object of an extensive fishery in this State. Important canning industries are developing, yielding various products, and clam "bedding" is being done on an increasing scale. The fishing of natural clam bottoms is perhaps at its maximum now, while the possibilities of clam culture are as yet problematic.

It is therefore important that the proper officials should examine bottoms with reference to the natural growth of both oysters and clams. The question to be decided would then be, is the bottom in question either a natural oyster bed or a natural clam bed?

The test of a bottom for clams is essentially the same as for oysters. A natural clam bottom might be defined as one whereon clams occur naturally and in sufficient abundance for an ordinary clammer to make a daily wage.

IV. LIBERTY OF LESSEE AND SEED CULTURE.

The lessee should be unrestricted in his methods of working his leased ground or in the place or manner of marketing the products from his grounds. The restrictions applying to the fishing of oysters on the public grounds, in order that the oystermen of small means shall not be placed at a disadvantage with the larger oystermen, and to prevent rapid exhaustion of the public beds, should not be applicable to the private bottoms. Thus, if two persons are working side by side on public grounds, one may be placed at a disadvantage by certain methods employed by the other; but if one is at work on his own ground where the other cannot enter, his methods cannot in any way hamper or concern the other. The wisdom of leaving every oyster farmer liberty to work his bottoms in the most economical way, as long as he carries out the provisions of his lease, will be just as well recognized as the wisdom of permitting every cotton or tobacco farmer liberty to work his lands in the most economical manner.

It is a wise provision of the general oyster law that prevents the shipping into other States of seed oysters taken from the natural rocks or bottoms. The clause should, however, be so framed that it would not prevent the exportation of seed grown on shells or other cultch artificially planted on leased grounds. With our present knowledge of the natural history of the oyster, it is believed that the spat which sets on certain shells would probably have been entirely lost had not this cultch presented itself. Certainly the future of the oyster industry is in no way menaced by shipping out of the State seed from private grounds. The Commissioners of New Jersey deplore the fact that their planters swell the profits of Connecticut oyster cultivators by buying seed from them;[1] while they boast that they do in some regions (Newark Bay) grow a seed that they can ship[2] to the Pacific Coast, and urge that their State should supply other States with seed.[3] Connecticut supplies Rhode Island with seed.[4]

It is easy to distinguish between the folly of shipping out of the States seed oysters from the productive natural rocks—thus depleting our own beds—and the wisdom of shipping excess seed from artificial beds—thus utilizing that which might otherwise be waste. It would, however, become necessary that the inspectors at South Mills and Coinjock have some means of assuring themselves that a given cargo of seed oysters is from private rather than public beds. The burden of proof may well be placed on the captain of the vessel carrying the seed, and there may be provided by law a means by which this proof can readily be obtained.

It is very probable that the raising of seed oysters may offer a particularly good opportunity for oystermen of small means, as they can purchase shells at 1½ cents per bushel, and, by furnishing their own labor, plant them at odd times without extra expense. To grow large oysters might require rehandling and more care than they could afford to give; but they could, after a year or two, market the seed at probably 10 cents, 15 cents or even 20 cents per bushel, which, with a liberal discount for loss of shells, will leave a good margin of profit. Although it cannot be *positively* stated at the present time, without further practical demonstration, that the growing of large oysters will prove profitable, it is a practical certainty that seed oysters can be grown successfully. The experimenting planter will, therefore, have two opportunities for profit in his oyster cultivation. There are some who cannot afford to wait three or four years for the first returns from their investment, but who can plant and await the greater profits of the cultivation of large oysters, provided they may have at least a small return during each of the first few years, and such planters might accomplish this end by planting a portion of their holdings for seed oysters. Therefore, if there is any argument advanced against shipping out of the State seed oysters raised from private bottoms, it would yet be strongly advisable that no such restriction be placed until the industry has passed the experimental stage.

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[1] Report of the Commission for the Investigation of the Oyster Industry. New Jersey, 1902, pp. 14, 17, 20.

[2] Report of the Commission for the Investigation of the Oyster Industry. New Jersey, 1902, pp. 7, 10.

[3] Report of the Commission for the Investigation of the Oyster Industry. New Jersey, 1902, p. 17.

[4] Annual Report of the Commissioner of Shell Fisheries. State of Rhode Island and Providence Plantations. January, 1904, p. 4.

In this connection it is well to call attention to the fact that in the upper waters of Roanoke Sound there is a large area which is not suitable for the growing of large oysters, but which can be made useful for the growing of seed. Almost every year the abundant young oysters are killed out by the influx of fresh water from Albemarle Sound; yet these young oysters might have been of great economic value if they had been shipped as seed. It is reported that lower down in this Sound each annual set is overcrowded the next year and the growth rendered valueless for market purposes. Thus, there are regions, and not only in Roanoke Sound, but in other places (on shoals, etc.), which have great potential value, not, however, for the growth of large oysters, but only as grounds for the production of seed oysters.

For these reasons it can be seen that great care should be taken that whatever restrictions are made relative to the shipping of seed oysters do not interfere with the cultivation and shipment of seed from such bottoms as are not capable of raising large oysters and also with the cultivation and shipment of seed from private gardens.

It is difficult to get at the bearing of present laws on this matter of shipment of seed. Express provision could be made that sections 3, 11 and 17 of chapter 516, Public Laws 1903, or any other law, should not be construed to prohibit the cultivation and shipment of seed as described above.

Sec. 3. Provides for seizure of vessels or trains on which are loaded oysters not properly culled. Offering unculled oysters for sale a misdemeanor.

Sec. 11. Provisions for culling oysters.

Sec. 17. Provisions for purchase of oysters to carry out of State by vessel.

The possibilities of the cultivation of clams are unknown. But experiments on this line are to be encouraged. Hence, a lessee should be authorized to use his grounds *for the cultivation of either oysters or clams.*

V. MAXIMUM AREA.

The maximum area a lessee may enter under our present law is ten acres. In most cases such a limit is unduly small. Ten acres might be a reasonable limit in creeks and small bays; also, where an individual does all of his own work, planting, cultivating, tonging and marketing, he will undoubtedly find that ten acres will be all that he can take care of to carry out the full provisions of his lease. On the other hand, however, it seems unnecessary that a planter who is so situated that he can handle a greater acreage and give employment to oystermen and boatmen should be limited to ten acres. In no other

State with an important oyster-planting industry is this maximum limit so low, and such limitation of area is not justified by expediency or economy.

It is an error, too, to apply in the open waters of Pamlico Sound the same limit that is adapted to bays or shore bottoms. No one has undertaken or can be expected to undertake to cultivate a ten-acre garden several miles off-shore in Pamlico Sound, for one could not afford to use, in planting and working such a small garden, the methods that such a location would require. The planter would not even be able to employ a watchman. Clearly it is not wise to have a limit so small that, if the object that the law intends to further is carried out, it is done only by evasion of the law. In the open waters of Pamlico Sound one hundred acres would be a small enough limit—and then far smaller than the limit in any other State with a prosperous oyster-planting industry (Virginia, Rhode Island, Connecticut, New York). Even in bays, twenty-five acres would be sufficiently small. The conditions of the lease can be so adjusted, as will be seen below, that a planter, entering more acreage than he can successfully take care of, will have to give up his excess acreage and allow it to revert to the State.

VI. RENTAL OF BOTTOMS.

There are a number of reasons why an annual rental should be charged for the leased grounds. This rental should be large enough to be a source of revenue to the State, yet not so large as to prevent a man of small means from taking up sufficient land to employ himself and his family. It should be in lieu of any other tax on oyster grounds. At present such grounds are assessed for taxation at a valuation usually of one dollar per acre; so that the State receives but a few cents in return for the franchise granted. One of the good features of a rental fee is that it will discourage a lessee from entering, or retaining after a trial, greater acreage than he can successfully cultivate.

But it may properly be urged that a prospective planter should receive every encouragement to undertake oyster culture. For this reason the suggestion has been made that no rental be charged for the first year of the lease, in consideration of the expenses devolving on the lessee in connection with the examination and survey of the bottom. During succeeding years the annual charge may be fixed at fifty cents or more per acre; for, if the planting proves profitable enough to justify its continuance, the planter can afford to pay the State for the privileges enjoyed.

VII. REVERSION OF BOTTOMS TO THE STATE.

Provision should be made for the reversion of the bottoms to the State, provided planting is not done within a definite time or is not continued on a reasonable scale. The exact number of bushels of oyster shells that should be planted per acre each year cannot be stated; for this will vary with the character of the bottom and other conditions; also with the plan that the planter's judgment may approve as the best to use in developing his grounds; but a minimum number of bushels per acre should be decided upon. This should not be more than 100 bushels of seed or of oyster shells or an equal amount of other cultch per acre, to be planted within two years.

VIII. TERM OF LEASE.

The lease or franchise should be granted, not for an indefinite time, but for a term of years—say, twenty-five years. It is expedient that at the end of a period of years the State may have opportunity to revise the provisions of the lease, if it seems advisable, in order to adapt them to the state of the industry and other conditions prevailing at that time.

CONCLUSION.

In the preceding pages the fundamental legislative conditions that seem necessary for the building up of the oyster-planting industry, which at the present time is practically undeveloped, have been indicated and briefly discussed. The cultivation of the oyster offers employment and profits to individuals who will undertake planting; it will be not only a source of direct revenue to the State, but indirectly, through the resulting increase of taxable properties, should cause a large revenue. During the past year, 1904, there has been more oyster planting than during any recent year, and this is to be attributed in considerable measure to the results of the investigations that have been carried on by the North Carolina Geological Survey in conjunction with the United States Bureau of Fisheries. There are other persons interested in the cultivation of the oyster who would plant if they could be assured of an incontestable title to the bottoms that they leased from the State. At no time in the history of the State has there been such a good opportunity as at the present time for the building up of a remunerative industry in the cultivation of the oyster; and with proper legislation, this industry should, within the next few years, become a profitable business throughout many districts along the coast of North Carolina.

PRESENT LAWS RELATING TO LEASING OF BOTTOMS.

The laws relating to the leasing of bottoms, as enacted by the Legislature of 1905, are as follows:

[Public Laws of North Carolina, 1905, Chapter 525.]

AN ACT TO AMEND AND SUPPLEMENT CHAPTER 516 OF THE PUBLIC LAWS OF 1903, IN RELATION TO THE OYSTER INDUSTRY.

Sec. 2. That any person who is and has been continuously for two years a *bona fide* resident of the State of North Carolina and over twenty-one years of age may lease or enter not more than fifty acres of any bottom where oysters do not naturally grow, or on any ground where there is not a sufficient growth of oysters to justify at the time of leasing the gathering of the same for profit. When any person desires to lease or enter any such ground he shall advertise the fact at the court-house and three other places for four weeks in the county where said bottom desired to be leased is located, and advertise in some newspaper published in said county for four weeks, and if there be none published in said county, then in a newspaper published in an adjoining county. Application for such land shall be made to the Clerk of the Superior Court, who shall appoint a man, and the applicant shall choose another, which two so chosen shall appoint a third man, and the three shall constitute a board of arbitration, and the said board of arbitration shall inspect the bottom desired to be leased, and if they find the same subject to lease and so report to the clerk, then it shall be the duty of the said clerk to issue a lease as herein provided, and for such service the clerk shall receive the following fees, to-wit: Twenty-five cents for the application, twenty-five cents for the appointment and twenty-five cents for filing the report of arbitration, and copy-sheet fees for recording such lease and other papers necessary to be recorded. Such bottom shall be surveyed by the County Surveyor; all cost and expense to be paid by the lessee, who shall also pay a yearly rental of fifty cents per acre, which rental shall be paid to the Oyster Commissioner and go to the benefit of the oyster fund. A failure to pay rental for two years shall render the lease null and void. No bottom which has been surveyed prior to the passage of this act need be resurveyed where such leases are plainly marked at the time of the passage of this act. That the County Surveyor shall furnish the lessee a map or plot free of charge. No lease shall be issued for any ground closer than two hundred yards to any natural oyster bed.

It may be noted that under this law now in effect:

1. Bottoms are subject to lease, which do not have a natural growth of oysters, or on which *"there is not a sufficient growth of oysters to justify at the time of leasing the gathering of the same for profit"*: *Provided,* the bottoms be not "closer than two hundred yards to any natural bed."
2. The limit of area is increased to fifty acres.
3. It is provided that the applicant shall properly advertise his application.
4. The lessee pays the expenses of the survey and papers and an annual rental of fifty cents an acre.
5. A "Board of Arbitration" is provided for.
6. This board shall consist of three members, one appointed by the Clerk of the Superior Court, one chosen by the applicant, and a third appointed by the first two.

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ibrary.

Only the last mentioned provision requires discussion. Each bottom applied for is examined by a board appointed for the examination of the particular bottom in question. The board ceases to exist after examining the bottom, and the responsibility of the board and its members then terminates. When another application is made another board acts. There will not, therefore, be uniformity in the decisions, and no one has any permanent responsibility in the matter. The arrangement seems to leave room for the play of local sentiment, and for irresponsible decisions. In the case of the only application so far made in Carteret County, September, 1905, persons appointed by the Clerk of the Superior Court and by the applicant have declined to serve, and after a number of weeks, a board has not been formed.

While the workings of the law may yet prove otherwise, the law seems defective in the matter of provision for the formation of the Board of Arbitration. It would seem more satisfactory to have the responsibility regarding the leasing of bottoms vested in a permanent commission appointed or elected in the several counties, or assigned to a commission already in existence, such as the Oyster Commission. If the former alternative were followed, and the duty of examination assigned to boards appointed by the Governor for a term of years, the members of a board should receive a fixed compensation and necessary expenses while making an examination, the entire expense to devolve on the applicant. While this would considerably increase the initial expense of the applicant, it has been previously suggested that the rental for the first year be remitted in consideration of this first cost. Either of the arrangements suggested would bring about approximately uniformity of decisions and would increase the responsibility of the officials concerned.

It should be expressly stated that the lease when granted *shall be incontestable except in the event of failure on the part of the lessee to fulfill his part of the contract, and that the removal of shell-fish from leased bottoms without authority from the owner shall be regarded as larceny.* The need for such express provision may be understood from remarks previously made (pp. 10-13 above with footnote, p. 11).

It may be well to call attention to important points not touched by the present law. These are—

The protection of the natural clam beds from entry.

Matter of seed culture.

The permission to use the leased bottoms for either oyster or clam culture.

NORTH CAROLINA LAWS RELATING TO OYSTERS.

There is given below all the laws relating to oysters as given in the Revisal of 1905 of the Laws of North Carolina:

II. OYSTER BEDS.

2371. Natural, defined. A natural oyster or clam bed, as distinguished from an artificial oyster or clam bed, shall be one not planted by man, and is any shoal, reef or bottom where oysters are to be found growing in sufficient quantities to be valuable to the public.

1893, c. 287, s. 1.

2372. Planted in certain territory. Any inhabitant of this state may make a bed in any of the waters of this state, except that part designated as lying south of Roanoke and Croatan sounds and north of Core sound, and lay down or plant oysters or clams therein, having first obtained license as hereinafter directed from the superior court clerk of the county wherein such bed may be, and he may stake out the grounds so as to include not exceeding ten acres with good and substantial stakes, extending at least two feet above high watermark, and placed at such intervals as to make the boundaries of such bed or garden distinctly known; and every person who shall obtain such license shall hold the same and have exclusive privilege thereof to him, his heirs and assigns. But no person may have more than one such bed in the same county: Provided, nothing herein shall be construed to affect the rights of any owner or proprietor of lands in which there may be creeks or inlets, or which may be adjacent to any navigable waters, or to authorize any person to appropriate to his own use, or to stake off and enclose any natural oyster or clam bed, or in anywise to infringe the common right of the citizens of the state to any such natural bed or to obstruct the free navigation of the waters aforesaid.

Code, s. 3390; 1883, c. 332, ss. 1, 2.

2373. How license is obtained. Whenever a license is desired according to the preceding section the clerk of the superior court of the county wherein the proposed oyster or clam bed may be may, in his discretion, grant a license to make such oyster or clam bed to any inhabitant of this state who shall apply therefor as herein provided; such applicant shall first stake off the proposed oyster or clam bed as provided in the preceding section, and shall publish a notice for thirty days at the courthouse door of the county wherein said bed is proposed, designating the location thereof as near as may be and the day when he will apply for the issuing such license. Upon the day named in said notice, upon which application for such license is to be made, any inhabitant of such county shall have the right to appear before said clerk and object to the issuing of such license by filing an affidavit stating that the proposed oyster or clam bed is a natural oyster or clam bed. If the said applicant shall refuse to file an affidavit denying the proposed oyster or clam bed is a natural bed, the said clerk shall refuse to grant such license. If such applicant shall file an affidavit denying that such proposed bed is a natural bed, it shall be the duty of such clerk to transmit said affidavits to the next term of the court of said county, and at said term the issue shall be tried to determine whether the proposed bed is a natural bed, and after such trial the said clerk shall grant or refuse said license in accordance with the judgment rendered upon the determination of such issue.

Code, s. 3391; 1893, c. 287, s. 2.

2374. County commissioners to cause survey to be made. The board of county commissioners may in their discretion cause to be made, not oftener than once in twelve months, a survey and examination of any and every such oyster or clam bed or garden in their county, the result of which examination or survey shall be reported under oath to the clerk of the superior court; and if it be found that the holder of such license as aforesaid has included within his stakes any natural oyster or clam bed, or a space containing more than ten acres, he shall forfeit such license and all the rights and privileges thereto belonging; further, if the holder of such license fail for the space of two years either to use such bed or to keep it properly designated by stakes, he shall forfeit such license and all the rights and privileges therein granted.

Code, s. 3392; 1883, c. 332, s. 4.

2375. Under control of the state. The state shall exercise exclusive jurisdiction and control over all shell-fisheries which are or may be located in the boundaries of the state south of Roanoke and Croatan sounds and north of Core sound, and for the purposes of this chapter the southern boundary line of Hyde county shall extend from the middle of Ocracoke inlet to the Royal Shoal lighthouse, thence across Pamlico sound and with the middle line of the Pamlico and Pungo rivers to the dividing line between the counties of Hyde and Beaufort, and the northern boundary line of Carteret county shall extend from the middle of Ocracoke inlet to the Royal Shoal lighthouse, thence to the Brant Island Shoal lighthouse, thence across Pamlico sound to a point midway between Maw point and Point of Marsh, and thence with the middle line of the Neuse river to the dividing line between the counties of Carteret, Craven or Pamlico, and that portion of Pamlico sound and the Neuse and Pamlico rivers not within the boundaries of Dare, Hyde or Carteret counties, and not a part of any other county, shall be in the county of Pamlico, and for the purposes of this chapter and in the execution of the requirements thereof, the shore line as now defined by the United States coast and geodetic survey shall be accepted as correct.

1887, c. 119, ss. 1, 2.

2376. How beds entered. Any person a citizen and bona fide resident of the state desiring to raise, plant or cultivate shell-fish upon any ground in the county, and within the territory described in the preceding section, which has not been designated as public ground by the board of shell-fish commissioners and which is not a natural clam or oyster bed, may make application in writing, in which shall be stated as nearly as may be the area, limits and location of the ground desired, to the entry-taker of the county in which the said area for which application is made is situated, for a franchise for the purpose of raising or cultivating shell-fish in said grounds, and the said entry-taker having received said application shall proceed as with all other entries as provided in the chapter entitled Grants, except that the warrant to survey and locate the ground or grounds shall be delivered to the engineer appointed by the secretary of state and not to the county surveyor; and the said engineer shall make such surveys in accordance with the provisions of the chapter entitled Grants, except that it shall not be necessary to employ chainbearers nor to administer oaths to assistants, nor to make surveys, according to the priority of the application or warrant. No entry shall be made to cover any natural oyster or clam bed as defined in this chapter, nor of any land lying more than two miles from the main land or from any island.

1887, c. 119, s. 5; 1893, c. 272.

2377. How leased. Any person who is and has been continuously for two years a bona fide resident of the state of North Carolina and over twenty-one years of age may lease or enter not more than fifty acres of any bottom where oysters do not naturally grow or on any ground where there is not a sufficient growth of oysters to justify at the time of leasing the gathering of the same for profit. When any person desires to lease or enter any such ground he shall advertise the fact at the courthouse and three other places for four weeks in the county where said bottom desired to be leased is located, and advertise in some newspaper published in said county for four weeks, and if there be none published in said county, then in a newspaper published in an adjoining county. Application for such land shall be made to the clerk of the superior court, who shall appoint a man and the applicant shall choose another, which two so chosen shall appoint a third man and the three shall constitute a board of arbitration, and the said board of arbitration shall inspect the bottom desired to be leased, and if they find the same subject to lease and so report to the clerk, then it shall be the duty of the said clerk to issue a lease as

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herein provided, and for such service the clerk shall receive the following fees, to-wit: Twenty-five cents for the application, twenty-five cents for the appointment and twenty-five cents for filing the report of arbitration, and copy-sheet fees for recording such lease and other papers necessary to be recorded. Such bottom shall be surveyed by the county surveyor; all cost and expense to be paid by the lessee, who shall also pay a yearly rental of fifty cents per acre, which rental shall be paid to the oyster commissioner and go to the benefit of the oyster fund. A failure to pay rental for two years shall render the lease null and void. No bottom which has been surveyed prior to sixth day of March, one thousand nine hundred and five, need be re-surveyed where such leases are plainly marked at that time. The county surveyor shall furnish the lessee a map or plot free of charge. No lease shall be issued for any ground closer than two hundred yards to any natural oyster bed.

1905, c. 525, s. 2.

2378. Secretary of state to issue grant; amount granted limited. The secretary of state, on receipt of the auditor's certificate as provided in the chapter on Grants, shall grant to the applicant a written instrument conveying a perpetual franchise for the purpose of raising and cultivating shell-fish in and to the grounds for which application is made; and the said written instrument of conveyance shall be authenticated by the governor, countersigned by the secretary and recorded in his office. The date of the application for the franchise and a description of the ground for which such franchise was granted shall be inserted in each instrument, and no grant shall issue except in accordance with a certificate from the engineer appointed by the secretary of state as to the area, limits and location of the grounds in which the said franchise is to be granted, and every person obtaining such grant or franchise shall, within three months from the receipt of the same, record said written instrument in the office of the register of deeds for the county wherein the said grounds may lie and shall define the boundaries of the said grounds by suitable stakes, buoys, ranges or monuments; but no franchise shall be given in or to any of the public grounds as determined by the commissioners of shell-fisheries, or to any natural oyster or clam bed, and all franchises granted under this section or any previous law shall be and remain in the grantee, his heirs and legal representatives: Provided, that the holder or holders shall make in good faith within five years from the day of obtaining said franchise an actual effort to raise and cultivate shell-fish on said grounds. No grant shall be made to any one person of more than ten acres of any territory, and no person shall hold more than ten acres in any creek unless the same shall be acquired through devise, inheritance or marriage.

1887, c. 119, s. 6; 1893, c. 272.

2379. Price paid for franchise. Not less than seventy-five cents per acre shall be paid to the state treasurer for all franchises granted, and in all other respects as to protests of entry and the right of the secretary of state to sell to any one else at an increased price the chapter on Grants shall apply.

1887, c. 119, s. 7.

2380. Liable to taxation. All grounds taken up or held for the purpose of cultivating shell-fish shall be subject to taxation as real estate, and shall be so considered in the settlement of the estates of deceased or insolvent persons.

1887, c. 119, s. 9.

2381. Books of records of grants kept. The secretary of state shall keep books of record in which shall be recorded a full description of all grounds granted under the provisions of this chapter, and shall keep a map or maps upon which shall be shown the positions and limits of all public and private grounds.

1887, c. 119, s. 14.

2382. Form of grants approved by attorney general. Entry-takers shall make return to the secretary of state of all franchises granted under this chapter, in the same manner as provided in the chapter entitled Grants, and the provisions of that chapter are hereby extended so as to cover the grants or franchises in ground for raising or cultivating shell-fish as authorized by this chapter; and all applications, grants, warrants and assignments of franchises in or to oyster grounds shall be in manner and form as approved by the attorney general of the state.

1887, c. 119, s. 12.

III. Catching Oysters.

2383. Close season, exception. If any person shall buy or sell oysters in the shell which have been taken from the public grounds or natural oyster beds of this state between the first day of April and the first day of October in any year, he shall be guilty of a misdemeanor and be fined not more than fifty dollars or imprisoned not more than thirty days: Provided, that oysters may be taken with hand-tongs only during the month of April in any year, to be used for planting on private grounds, entered and held under the laws of this state: Provided further, that oysters may be taken with hand-tongs only for home consumption: Provided further, that coon oysters may be taken from October first to May first of each year in the waters of Onslow and Carteret counties: Provided also, that it shall be lawful to take or catch oysters on public oyster grounds north of the line running from Point Peter to Duck Island, except between a line running from the east end of Hog Island to the beach and from

Ballast Point to the beach in Dare county, to be sold to residents or nonresidents, from April first to May fifteenth of each year, upon the payment by the purchaser of a tax of one and one-half cents per tub.
1903, c. 516, s. 22; 1905, c. 525, ss. 5, 8.

2384. At night or on Sunday. If any person shall catch or take any oysters from any of the public grounds or natural oyster beds of the state at night or on Sunday, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.
1903, c. 516, s. 16.

2385. Illegal dredging. If any person shall use any scoops, scrapes or dredges for catching oysters except at the times and in the places in this chapter expressly authorized, or shall between the fifth day of April and the fifteenth day of November of any year carry on any boat or vessel any scoops, scrapes, dredges or winders, such as are usually or can be used for taking oysters, he shall be guilty of a misdemeanor.
1903, c. 516, ss. 13, 14, 15.

2386. Catching oysters without license. If any person shall catch oysters from the public grounds of the state without having first obtained a license according to law, or shall employ any person as agent or assistant, or shall as the agent or assistant of any person catch oysters from the public grounds, without all of said persons having first obtained a license according to law, he shall be guilty of a misdemeanor, and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.
1903, c. 516, s. 6.

2387. Using boats not licensed. If any person shall use any boat or vessel in catching oysters, which boat has not been licensed according to law, and which is not in all respects complying with the law regulating the use of such vessels, he shall be guilty of a misdemeanor and shall be fined not more than fifty dollars nor less than ten dollars or imprisoned not more than thirty nor less than ten days for the first offense, but for the second or subsequent offense he shall be guilty of a misdemeanor and punished at the discretion of the court.
1903, c. 516, s. 8.

2388. Displaying false number on boat. If any person shall display any other number on their sail than the one specified in their license or display a number when the boat or vessel has not been licensed, he shall be guilty of a misdemeanor and shall be fined not less than twenty-five dollars.
1903, c. 516, s. 27.

2389. Failure to stop and show oyster license. If any person using a boat or vessel for the purpose of catching oysters shall refuse to stop and exhibit his license when commanded to do so by the oyster commissioner, assistant commissioner or any inspector, he shall be guilty of a misdemeanor and be fined not less than twenty-five dollars nor more than fifty dollars.

1903, c. 516, s. 26.

2390. False statement in application for oysterman's license. If any person shall make any false statement for the purpose of procuring any license, which may be required by law, to catch oysters, or to engage in the oyster industry, he shall be guilty of perjury and punished as provided by law.

1903, c. 516, s. 17.

2391. Dredging in prohibited waters. If any person, after the governor has by proclamation suspended the right to use scoops, scrapes or dredges on the public grounds or natural oyster beds of the state, shall during the time of such suspension, and in the waters as to which the right has been suspended, use such instruments or implements to catch oysters from any of the public grounds or natural oyster beds of the state, he shall be guilty of a misdemeanor and be fined not less than five hundred dollars or imprisoned not less than twelve months, and the boat or vessel used for this purpose shall be forfeited and shall be seized, advertised and sold by the oyster commissioner or by the inspectors in the county wherein said illegal act was committed and the proceeds paid into the oyster fund. In any prosecution for the violation of the provisions of this section against the master or owner of a boat or vessel, proof that said boat or vessel was equipped with scoop, scrape or dredge or other implement or instrument for catching or taking oysters other than ordinary oyster tongs shall be prima facie evidence of the defendant's guilt.

1903, c. 516, s. 19.

2392. Selling oysters not culled. If any person shall sell or offer for sale, transport or offer to transport out of the state, or from one point in the state to another, or have in his possession any oysters, which have not been properly culled according to law, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.

1903, c. 516, s. 3.

2393. Oysters where purchased to be carried out of the state. If any person shall purchase and load on any vessel or boat any oysters to be carried out of the state in the shell, except at the following places, to-wit: The south end of Roanoke Island, Stumpy Point Bay, Parched Corn Bay, Wysocking Bay, West Bluff Bay, Great Island

Narrows or Swan Quarter Bay (as the oyster commissioner may determine), Portsmouth, Ocracoke, Bay River, mouth of Rose Bay or Harbor Island; or if any person shall load more than one boat or vessel at any of said places at one and the same time, or if any person shall load any boat or vessel with oysters to be carried out of the state without such vessel having an inspector on board at the time the oysters are delivered, or shall carry any vessel loaded or partly loaded with oysters through the canals without a certificate showing that the oysters have been inspected and the taxes thereon paid, he shall be guilty of a misdemeanor and be fined not more than fifty dollars or imprisoned not more than thirty days.

1903, c. 516, s. 17.

2394. Unloading oysters on Sunday or at night. If any person shall unload any oysters from any boat, vessel or car at any factory or house for shipping, shucking or canning oysters on Sunday, or after sunset or before sunrise, he shall be guilty of a misdemeanor and be fined not more than fifty dollars or imprisoned not more than thirty days: Provided, whenever any boat or vessel shall have partially unloaded or discharged its cargo before sunset, the remainder of said load or cargo may be discharged in the presence of an inspector.

1903, c. 516, s. 16.

2395. Dealing in oysters without license. If any person shall engage in the business of buying, canning, packing, shipping or shucking oysters without having first obtained a license as required by law, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.

1903, c. 516, s. 9.

2396. Dealer failing to keep record. If any person engaged in buying, packing, canning, shucking or shipping oysters shall fail to keep a permanent record of all oysters bought by him or caught by him, or by persons for him, when and from whom bought, the number of bushels and the price paid therefor, or shall fail upon demand to exhibit such record as required by law, or shall fail to verify the same, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.

1903, c. 516, s. 5.

2397. Evidence of illegal dredging. If any boat or vessel shall be seen sailing on any of the waters of this state during the season when the dredging of oysters is prohibited by law in the same manner in which they sail to take or catch oysters with scoops, scrapes or dredges, the said boat or vessel shall be pursued by any officer authorized to make arrests, and if said boat or vessel apprehended by said officer shall be found to have on board any wet oysters or the scoops, scrapes, dredges or lines, or deck wet, indicating the taking or catching of oysters at said time, and properly equipped for catching or taking oysters with scoops, scrapes or dredges, such facts shall be prima facie evidence that said boat or vessel has been used in violation of the provisions of the law prohibiting the taking or catching of oysters with scoops, scrapes or dredges in prohibited territory, or at a season when the taking or catching of oysters with scoops, scrapes or dredges is prohibited by law, as the case may be.

1903, c. 516, s. 28.

2398. Arrests without warrant, when and how made. The oyster commissioner, assistant oyster commissioner and inspector shall have power with or without warrant to arrest any person violating any of the oyster laws.

1903, c. 516, s. 2.

2399. Using illegal measures for oysters. If any person shall in buying or selling oysters use any measure other than that prescribed by law for the measurement of oysters, or if any dealer in oysters shall have in his possession any measure for measuring oysters other than that prescribed by law, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.

1903, c. 516, s. 12.

2400. Catching oysters for lime. If any person shall take or catch any live oysters to be burned for lime or for any agricultural or mechanical purpose, he shall be guilty of a misdemeanor and be fined not exceeding fifty dollars or imprisoned not exceeding thirty days.

Code, s. 3389; 1885, c. 182.

2401. Larceny of oysters on private beds. Any person who shall feloniously take, catch or capture or carry away any shell-fish from the bed or ground of another shall be guilty of larceny and punished accordingly.

1887, c. 119, s. 15.

2402. Oysters caught at night; injury to private beds. If any person shall wilfully commit any trespass or injury with any instrument or implement upon any ground upon which shell-fish are being raised or cultivated, or shall remove, destroy or deface any mark or monument lawfully set up for the purpose of marking any grounds, or who shall work on any oyster ground at night, he shall be guilty of a misdemeanor. But nothing in the provisions of this section shall

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be construed as authorizing interference with the capture of migratory fishes or free navigation or the right to use on any private grounds any method or implement for the taking, growing or cultivation of shell-fish.

1887, c. 119, s. 11.

IV. Oyster Industry Regulated.

2403. Commissioner and assistant, how appointed, removed; term; salary; bond; oath of office. For the purpose of enforcing the oyster law, the governor shall appoint an "oyster commissioner" and an assistant "oyster commissioner," whose term of office shall be two years, or until their successors are appointed and qualified. They may be removed by the governor at any time for cause. The commissioner shall give bond in the sum of two thousand dollars; the assistant commissioner shall give bond in the sum of one thousand dollars. The bonds shall be payable to the state of North Carolina, shall be conditioned for the faithful discharge of their office, and the proper accounting for all moneys received, shall have at least two sufficient sureties, and shall be approved by and filed with the clerk of the superior court of the county in which the officer resides and be a part of the records of his office. They shall take and subscribe oaths to support the constitution and for the faithful performance of the duties of their office, which oaths shall be filed with the bond. The salary of the commissioner shall be nine hundred dollars per annum, and he shall be allowed three hundred dollars for expenses. The salary of the assistant commissioner shall be seven hundred and fifty dollars per annum. The salaries shall be payable monthly.

1903, c. 516.

2404. Inspectors, how appointed; term; salary; bond; oath of office. The oyster commissioner shall appoint, from the counties within which they are to perform their duties, a sufficient number of inspectors who shall serve during the oyster season, and may remove them for cause. He shall fix the compensation of the inspectors at not exceeding fifty dollars a month while on duty, and shall designate the length of service, the time when the inspectors go on duty, and when they go off. The inspectors shall give bond in the sum of five hundred dollars, payable to the state of North Carolina, conditioned for the performance of the duties of their office, and the faithful accounting for all moneys received, which bond shall have at least two sufficient sureties, to be justified before approved by and filed with the clerk of the superior court of the county where they reside, and shall take, subscribe and file with such clerk an oath of office. They shall be paid only for the time they serve.

1903, c. 516.

2405. Duties of the oyster commissioner. The oyster commissioner shall have a general supervision over every branch of the oyster industry, and see that the laws regulating the same are rigidly enforced. He shall furnish the inspectors and the clerks of the superior courts of the several counties mentioned in this subchapter such receipt and record books, and other kinds of stationery as may be necessary to keep a correct record and account of all the money collected and all information necessary to be kept. Such stationery shall be furnished by the commissioner of labor and printing upon requisition of the oyster commissioner. He shall see that the law regulating the catching and handling of oysters is enforced; that no illegal methods are used in catching, selling or shipping; that the cull law is rigidly enforced, and that only proper and legal measures are used in buying and selling. He shall prosecute all violations of the law, and whenever it is necessary he may employ counsel for this purpose. He may also employ or charter sail vessels, tugs and other boats when necessary to the performance of the duties of his office. He shall in his official capacity have power to administer oaths and to send for and examine persons and papers. He shall, on or before the twenty-fifth day of each month, mail to the treasurer of the state a consolidated statement showing the amount of taxes collected during the preceding month and by and from whom collected. He shall make a biennial report to the governor, setting forth in detail an account of his official acts, the condition of the oyster industry in all its branches, and shall recommend such additions to or modifications of existing laws relating thereto as he may deem proper and necessary. He shall have power and authority and it shall be his duty to make and prescribe all such reasonable rules and regulations as may be necessary and to carry into effect and operation the laws relative to the oyster industry according to its true intent and purposes.

1903, c. 516, ss. 3, 18.

2406. Duties of the assistant commissioner. The assistant oyster commissioner shall be charged with the special supervision, under the commissioner, of all matters relating to oyster industry in the different counties. He is particularly charged with the rigid enforcement of the cull feature of the law, the provisions against the use of illegal measures in buying or selling and the unlawful use of scoops, scrapes and dredges in the bays, creeks, straits, sounds, rivers and their tributaries and elsewhere where the same is prohibited.

1903, c. 516, s. 3.

2407. Duties of inspectors. The inspectors shall, under the commissioner and assistant commissioner, be charged with all matters relating to the oyster industry in their respective counties; they shall inspect all oysters offered for sale in their county, see that they

are properly culled, see that none of the provisions of the law regulating the oyster industry are violated, collect all taxes from dealers on oysters purchased or caught; keep a correct record of all taxes collected by them and from whom and for what purpose collected; and on or before the fifth day of each month mail to the oyster commissioner a report, on such form as he may prescribe, showing all taxes collected by them and from whom received, and at the same time pay over to the commissioner the amount of such taxes.
1903, c. 516, s. 3.

2408. Who may be licensed to catch oysters. No person shall be licensed to catch oysters from the public grounds of the state who is owner, lessee, master, captain, mate or foreman, or who owns an interest in or who is an agent for any boat that is used or that may be used in dredging oysters from the public grounds of the state, who is not a bona fide resident of this state and who has not continuously resided therein for two years next preceding the date of his application for license, and no nonresident shall be employed as a laborer on any boat licensed to dredge oysters under this subchapter who has an interest in or who receives any profit from the oysters caught by any boat permitted to dredge oysters on the public grounds of the state. Any person, firm or corporation employing any nonresident laborer forbidden by this section, upon conviction shall be fined not less than fifty dollars nor more than five hundred dollars.
1903, c. 516, s. 6; 1905, c. 525, s. 3.

2409. How license obtained to catch oysters; who may issue; form of. Any person desiring to catch oysters from the public grounds and natural oyster beds shall make and subscribe to the following oath, before some officer qualified to administer oaths:

I, ... (state if owner, lessee, master, captain, mate, foreman or agent of any boat used or that may be used in dredging oysters from the public grounds of the state), being an applicant for oyster license, do solemnly swear that I am a citizen of North Carolina and have been a resident of the state for the two years next preceding this day; that my place of residence is now in........ county; that I will not, if granted license, employ any nonresident or unlicensed person as an assistant or serve as an assistant to any nonresident who is owner, lessee, master, captain, mate or foreman, or who has any interest in, or in the profits derived from, any boat that is used or that may be used in dredging oysters from the public grounds of the state, or unlicensed person, nor will I transfer, assign or otherwise dispose of my license to any person, firm or corporation; that I will not knowingly or wilfully violate or evade any of the laws or regulations of the state relating to oyster industry; so help me, God.

He shall then present to and file said oath with the oyster commissioner, assistant oyster commissioner or inspector, who, if satisfied with the truth of the statement made in the oath of application, shall issue to him an oysterman's license in the following form:

State of North Carolina, ... County.

............, a resident of............county, having this day made application to me for an oysterman's license, and having filed with me the oath prescribed by law, I do hereby grant to him license to catch oysters from the public grounds of this state from the fifteenth day of October, ..., until the first day of next April. Witness my hand and official seal, this the......day of ....19....

....

Oyster commissioner, assistant oyster commissioner or inspector (as the case may be).

The said oath and a record of the license shall be kept by the oyster commissioner, assistant commissioner or inspector, and for issuing and recording the same he shall receive from the applicant a fee of twenty-five cents, which, together with all other license fees collected under this chapter, shall be paid over to the state treasurer and constitute part of the oyster fund. No fee shall be charged by the clerk for administering the oath.

1903, c. 516, s. 7; 1905, c. 525, ss. 4, 6.

Note. For making false affidavit, see Crimes.

2410. License for boat used in catching oysters. The oyster commissioner, assistant oyster commissioner or inspector may grant license for a boat to be used in catching oysters, upon application made, according to law, and the payment of a license tax as follows: On any boat or vessel without cabin or deck, and under customhouse tonnage, using scoops, scrapes or dredges, measuring, over all, twenty-five feet and under thirty, a tax of three dollars; fifteen feet and under twenty feet a tax of two dollars; on any boat or vessel with cabin or deck and under customhouse tonnage, using scrapes or dredges, measuring over all, thirty feet or under, a tax of five dollars; over thirty feet a tax of six dollars; on any boat or vessel, using scoops, scrapes or dredges, required to be registered or enrolled in the customhouse, a tax of one dollar and fifty cents a ton on gross tonnage. No vessel propelled by steam, gas or electricity, and no boat or vessel not the property absolutely of a citizen or citizens of this state on the first day of January, one thousand nine hundred and three, or unless built or owned in this state subsequent thereto and actually owned by a bona fide resident of this state under this chapter, shall receive license or be permitted in any manner to engage in the catching of oysters anywhere in the waters of this state. All boats or vessels so licensed to scoop, scrape or dredge oysters shall display on the port side of the jib, above the reef and bonnet and on the opposite side of mainsail, above all reef points, in black letters, not less than twenty inches long, the initial letter of the county granting the license and the number of said license, the number to be painted on canvas and furnished by the oyster commissioner, assistant oyster commissioner or inspector issuing the license, for which he shall receive the sum of fifty cents. Any boat or vessel used in catching oysters without having complied with the provisions of this section may be seized, forfeited, advertised for twenty days at three public places in the county where seized, and sold at some public place designated in the advertisement, and the proceeds paid into the oyster fund.

1903, c. 516, s. 8.

2411. License to oyster dealers. The oyster commissioner, assistant oyster commissioner or inspector shall, upon application and the payment of a fee of fifty cents, grant to the applicant a dealer's license, authorizing the applicant to engage in the business of buying, purchasing, canning, packing, shucking or shipping oysters. Such license shall not be issued prior to the fifteenth day of October of any year and shall expire on the first day of April following. The assistant oyster commissioner or inspector granting the license shall at once mail a duplicate to the oyster commissioner.

1903, c. 516, s. 9; 1905, c. 525, s. 6.

2412. Licenses reported monthly. The oyster commissioner, assistant oyster commissioner or inspector who are authorized to issue license or to collect a license tax, shall, on or before the fifteenth day of each month, mail to the oyster commissioner a statement, showing all licenses issued during the preceding month, to whom issued and for what purpose, and the amount of tax collected by them from all sources under the oyster laws, and shall at the same time remit said amount direct to the state treasurer. They shall at the same time mail to each inspector asking for the same a list of all persons to whom license has been issued and of all boats or vessels licensed, and for what purpose.

1903, c. 516, s. 4; 1905, c. 525, s. 6.

2413. Dredging, when allowed; prohibited territory. Any bona fide resident of the state duly licensed according to law and using a licensed boat or vessel may use scoops, scrapes or dredges in catching or taking oysters from the fifteenth day of November in each year to the first day of April following, from the public grounds and natural oyster beds in the broad open waters of Pamlico sound, Pamlico river, Neuse river and Long Shoal river, except in those portions of said sound and rivers in which the use of such instruments and implements is prohibited as herein provided. No person shall use any implement or instrument except hand-tongs in catching oysters in any bay, river, creek, strait, or any tributary of such which border upon or empty into Pamlico sound, Pamlico river, or Long Shoal river, except as hereinafter provided; and any point inside of a line drawn from the farthest or extreme outward point of land or marsh on the one side to the farthest or extreme outward point of land or marsh on the opposite side of any creek, strait or bay, shall be construed to be within the said creek, strait or bay for the purposes of this section. Nor shall any person use any implement or instrument except hand-tongs in the waters of Pamlico sound from what is known as the Reef or Reefs in the eastern portion of said sound to the line of banks bordering its eastern shores; nor along the shores of Pamlico county inside of a line beginning at Maw Point and running to the west end of Brant island, thence to Pamlico Point; nor in the waters of Pamlico sound north of a line running from Long Shoal light to Gull Shoal life-saving station, from the first day of February of each year to the fifteenth day of November, nor in any of the waters of Carteret county. And for the purpose of this section, the northern boundary of said county shall be a line extending from Swan Point to Harbor Island light, thence a line to Southwest Straddle light, thence a line to Northwest Point light, thence a line to the middle of Ocracoke Inlet; nor in the waters of Neuse river above a line in said river running from Carbacon buoy to the western point of land at Pierce's creek.

1903, c. 516, ss. 13, 14, 15; 1905, c. 507, s. 2.

2414. Governor may suspend right to dredge. The governor, upon the request of the oyster commissioner, may, whenever in his judgment it is necessary, by proclamation, suspend entirely the use of all scoops, scrapes or dredges in any of the waters of the state, either for a definite period of time or until the sitting of the next general assembly.

1903, c. 516, s. 19.

2415. Oysters culled on grounds. All oysters taken from the public grounds of this state, with whatsoever instrument or implement; shall be culled and all oysters whose shells measure less than two and one-half inches from hinge to mouth, except such as are attached to a large oyster and can not be removed without destroying the small oyster, and all shells taken with the said oysters shall be returned to the public ground when and where taken, and no oysters shall be allowed by the inspectors to be marketed which shall consist of more than ten per cent. of such small oysters and shells, except "coon" oysters and oysters largely covered with mussels: Provided, these musseled oysters must not contain more than five per cent. of shells or small oysters under regulation size.

1903, c. 516, s. 11; 1905, c. 525.

2416. Oysters not culled seized and put on public grounds. Whenever oysters are offered for sale or loaded upon any vessel, car or train, without having been properly culled according to law, the commissioner, assistant commissioner, or inspector shall seize the boat, vessel, car or train containing the same and shall cause the said oysters to be scattered upon the public grounds, and the costs and expenses of said seizure and transportation shall be a prior lien to all liens on said boat, vessel, car or train, and if not paid on demand the officers making the seizure shall, after advertisement for twenty days, sell the same and make title to the purchaser, and after paying expenses as aforesaid pay the balance, if any, into the oyster fund.

1903, c. 516, s. 3.
Note. For selling unculled oysters, see s. 2392.

2417. Dimensions of oyster measure. All oysters measured in the shell shall be measured in a circular tub with straight sides and straight, solid bottom, with holes in the bottom not more than one-half inch in diameter. The said measure shall have the following dimensions: A bushel tub shall measure eighteen inches from inside to inside across the top, sixteen inches from inside to inside chimb to the bottom and twenty-one inches diagonal from inside chimb to top. All measures used for buying or selling oysters shall have a brand, to be adopted by the oyster commissioner, stamped therein by said commissioner, assistant commissioner, or his lawful inspectors. All measures found in the possession of any dealer not meeting the requirements of this section shall be destroyed by said oyster commissioner, assistant commissioner or inspector.

1903, c. 516, s. 12.

2418. Dealers to keep records. All persons engaged in buying, packing, canning, shucking or shipping oysters shall keep a permanent record of all oysters either bought or caught by them, or by persons for them, when and from whom bought, the number of bushels and the price paid therefor. All these records shall at all times be open to the examination and inspection of the oyster commissioner, assistant oyster commissioner and inspector, and upon request shall be verified by the parties making them.

1903, c. 516, s. 5.

2419. Purchase tax. All dealers in oysters and all persons who purchase oysters for canning, packing, shucking or shipping shall pay a tax of one and one-half cents on every bushel of oysters purchased by them, or caught by them, or any one for them: Provided, that coon oysters shall be taxed one-half a cent a bushel only; and no oysters shall be twice taxed. This tax shall be paid to and collected by the inspectors, and when paid a receipt shall be given therefor. Upon failure or refusal by any person, firm or corporation to pay said tax, his license as a dealer shall at once become null and void, and no further license shall be granted him during the current year, and it shall be the duty of the commissioner, assistant commissioner or inspector to institute suit for the collection of said tax. Such suit shall be in the name of the state of North Carolina on relation of the commissioner or of the inspector at whose instance such suit is instituted, and the recovery shall be for the benefit and to the use of the general oyster fund.

1903, c. 516, s. 10; 1905, c. 507.

2420. Vessels with oysters, when allowed to go through canals. No boat or vessel loaded with oysters shall be permitted by the inspectors of South Mills and Coinjock to pass through the canals, which do not have a certificate showing that the cargo has been inspected and the tax paid thereon.

1903, c. 516, s. 17.

2421. Shells scattered on oyster beds. The oyster commissioner is hereby empowered to expend one-half of the balance to the credit of the oyster fund on the fifteenth day of April in each year for the purpose of buying oyster shells and scattering the same on the natural oyster grounds of the state during the months of April and May.

1903, c. 516, s. 20.

2422. Oyster funds kept separate, how paid out. The treasurer of the state shall keep all funds derived from the oyster industry separate and apart from other funds in the treasury and shall pay the same out only upon the warrant of the auditor, and the auditor shall issue no warrant on said fund in payment of any claim unless the same shall have been first approved by the oyster commissioner.

1903, c. 516, s. 20.

V. CLAMS.

2423. Clams. If any person between the first day of April and the first day of November of any year shall take any clams from the waters of Brunswick, New Hanover or Pender counties for the purpose of shipping, selling, marketing, or for bedding or pounding the same in any artificial bed, or if any person shall take or catch any oysters in the waters of Carteret county by dredging or scoops, or in any manner other than with the ordinary clam rake, or tongs, or if any nonresident shall take or catch any clams, he shall be guilty of a misdemeanor.

1901, c. 113; 1897, c. 333; 1899, c. 579; 1903, cc. 131, 414, 658, 732.

2928. May establish and regulate markets; street sales free, when. The board of commissioners may establish and regulate their markets, and prescribe at what place, within the corporation, shall be sold marketable things; in what manner, whether by weight or measure, may be sold grain, meal or flour (if the flour be not packed in barrels), fodder, hay, or oats in straw; may erect scales for the purpose of weighing the same, appoint a weigher, fix his fees, and direct by whom they shall be paid. But it shall not be lawful for the commissioners or other authorities of any town to impose any tax whatever on wagons or carts selling farm products, garden truck, fish and *oysters* on the public streets thereof.

Code, s. 3801; R. C., c. 111, s. 14; 1879, c. 176. Revisal of 1905, p. 885.

3444. Food misbranded or adulterated. If any person shall himself or by an agent or employee manufacture, sell, expose for sale, or have in his possession with intent to sell any article of food which is adulterated or misbranded, he shall be guilty of a misdemeanor, and shall be fined not exceeding two hundred dollars or be imprisoned not exceeding one year, or both. * * *

For the purpose of this section an article of food shall be deemed adulterated— * * *

8. If * * * In cases of meats, oysters or fish sold or offered for sale in the fresh state, if such meats, *oysters* or fish shall have been inoculated, dusted, powdered, sprayed, rubbed, anointed, washed, sprinkled or fumigated, or in any manner treated with any of the substances declared deleterious and dangerous by this section, or with any antiseptic or chemical preservative or dye-stuff whatsoever, whose use and apparent purpose is to retard, prevent or mask decomposition, or to give to the meat, *oysters* or fish a false appearance of freshness or quality. * * *

1895, c. 122; 1899, c. 86, ss. 2-6; 1899, c. 369; 1905, c. 306, ss. 3 and 4.

THE NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST.

Economic Paper No. 11.

THE MINING INDUSTRY

IN

NORTH CAROLINA DURING 1905

BY

JOSEPH HYDE PRATT, PH.D.

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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., December 1, 1906.

To His Excellency, HON. ROBERT B. GLENN,
Governor of North Carolina.

SIR:—I herewith have the honor to submit for publication Economic Paper No. 11, a Report on the Mining Industry in North Carolina for the Year 1905. In order to satisfy certain inquiries that are being received regarding the mining laws of North Carolina, there is given at the end of this report a list of the mining laws as given in the Revisal of The Code for 1905.

Yours obediently,
JOSEPH HYDE PRATT,
State Geologist.

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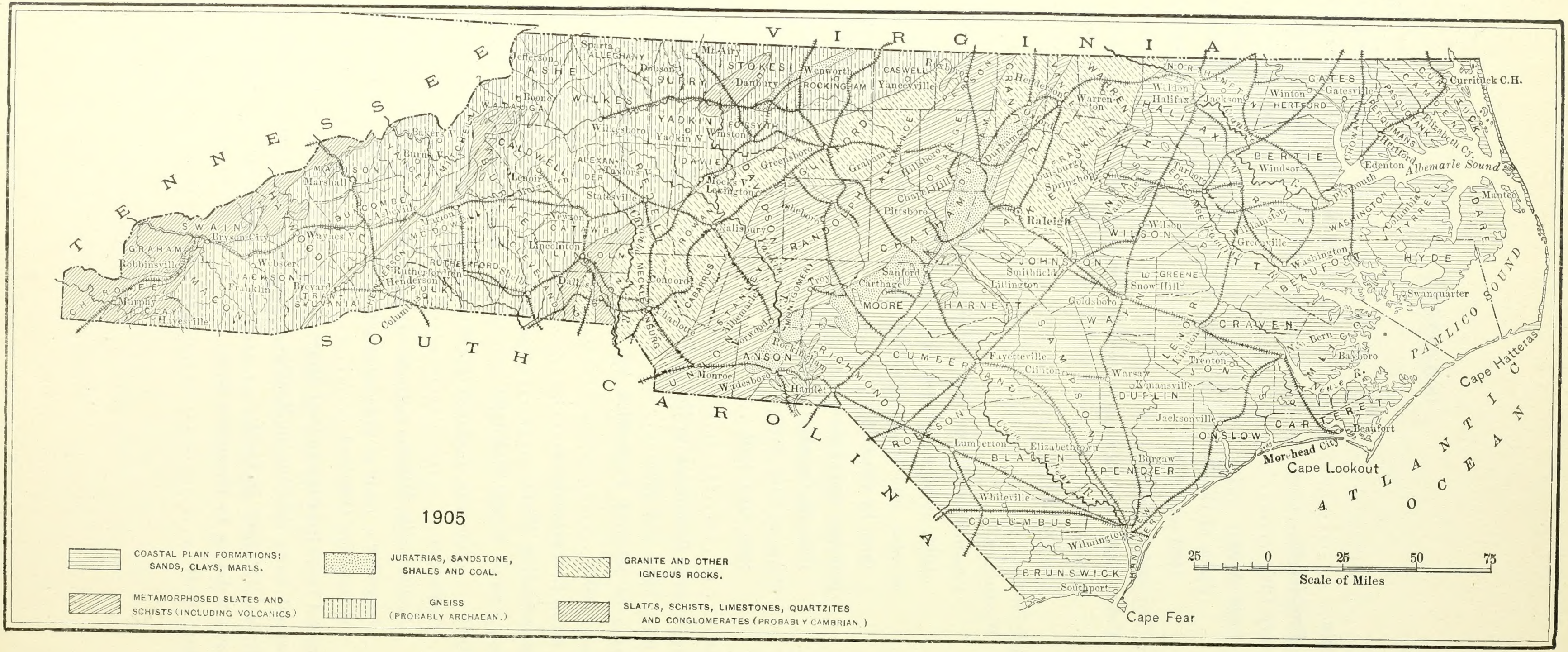
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MINING INDUSTRY IN NORTH CAROLINA DURING 1905.

By JOSEPH HYDE PRATT.

INTRODUCTION.

It is gratifying to note that during the year 1905 there was a decided increase in the production of those minerals which constitute North Carolina's chief mineral resources. Thus the productions of talc and soapstone, monazite, mica, building stones and clay products showed a very marked increase over the productions of 1904. In regard to building stones, the 1905 production was nearly twice that of the previous year and shows the remarkable growth of the building-stone industry in the State, due to systematic advertising and increased efficiency of quarrying methods. The Survey has coöperated with the producers of building stones and done all in its power to advance this industry in the State.

The production of clay products, which has constantly increased in value during the past five years, showed a decided gain in 1905, especially in value. Notwithstanding the large demand for brick and other clay products in the State and the increase in the value of these products, there is still a lack of enterprise on the part of most of the manufacturers of these in adopting new and up-to-date methods for working these clays. Thus they are only able to make the lowest grade of clay products, which are not able to command the high prices that are paid for a better quality of goods, the greater portion of which is now imported into North Carolina.

Of the two minerals, monazite and mica, North Carolina produces the greatest amounts of any State in the Union, and during 1905 it very largely increased its production of monazite as compared with that of 1904. The production of mica was only slightly increased over that of the previous year.

Of the heavy metals, such as gold, silver, and copper, North Carolina's production does not play a very important part at the present time in the total production of these mines in this country. Although the increase in the value of the production of these metals in 1905 as compared with 1904 was not large, yet there has continued to be a large amount of systematic development work carried on which has resulted in the opening of ore bodies of economic importance which will undoubtedly be mined and their metal contents placed on the market in the near future. A systematic investigation has been made during the past summer of the gold and copper mines of the State, and a preliminary report of the results of these investigations will be published shortly as an Economic Paper of the Survey publications.

Another mineral product that has caused considerable interest to center in North Carolina is tin, which has been mined in Gaston and Lincoln counties. Although the actual value of these tin deposits is still problematic and their success dependent largely on efficient management, yet the scarcity of this metal makes the North Carolina deposits of extreme interest, and a number of them are worthy of development, as they do offer possible chances of profitable investment if properly and economically managed.

The mining and quarrying industries of the State, as a whole, are perhaps in the most prosperous and flourishing condition ever known in the history of the State, and this cannot help but mean still greater activity in mining and a larger investment in the mineral resources of the State.

During 1905 the total value of the mineral production of North Carolina* was $2,439,381 as compared with $1,946,273 in 1904, an increase of $493,108. This increase is 25 per cent of the total production of 1904. The minerals and ores that have been mined in North Carolina during 1905 are given below in the order in which they are discussed in this report: Gold and Silver; Copper; Iron; Tin; Abrasive Materials (Corundum, Garnet, Millstones); Mica; Quartz (Flint); Barytes, Monazite and Zircon; Talc and Soapstone; Precious Stones; Mineral Waters; Graphite; Coal; Peat; Stone (Granite, Sandstone, Marble, and Limestone); Sand and Gravel; Sand-lime Brick; Kaolin and Clay Products; and Heavy Black Sands.

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*In the collection of the statistics of the production of the various minerals the State Survey has had the co-operation of the Department of Mineral Resources of the U. S. Geological Survey.

GOLD AND SILVER.

PRODUCTION.

The deposits of gold and silver have been described in detail in previous reports;* and still another report is now being prepared which will supplement the previous publications on these subjects. For this reason no attempt is made in the present report to give any description of the new work that has been done in the mining of these metals.

There was a small increase reported in the production of gold and silver in 1905 as compared with that of 1904. The total coining value of this production in 1905 was $149,369, which is an increase of $6,312 as compared with $143,057, the value of the production of 1904. Of the 1905 production $129,153 was due to the value of the gold produced, an increase of $5,229 as compared with $123,924, the value of the 1904 production. The value of the silver production was $20,216 as compared with $19,133 in 1904, an increase of $1,083. This production of 1905 consisted of 6,273 fine ounces of gold and 20,364 fine ounces of silver. The largest production of gold was from Montgomery County, with a production of gold valued at $61,000 and of silver at $1,600. Cabarrus County was second with a production of gold valued at $22,836, and of silver at $53.

On account of the death of Prof. George B. Hanna, Director of the United States Government Assay Office at Charlotte, N. C., in the spring of 1906, who had charge of the collecting and tabulating of the gold and silver statistics for North Carolina, it has been impossible this year to give these statistics in as much detail as in former years. Usually, it has been possible to give a list of all the counties producing gold, with the value of the production of each, and also to give a list of the principal producing mines. This year, however, it will simply be possible to give an approximate statement regarding the production of the principal producing counties, which is given in the following table.

---

* Bulletins 3 and 10, Economic Papers 6, 8 and 9, N. C. Geological Survey.

PRODUCTION OF GOLD AND SILVER IN 1905 BY COUNTIES.*

COUNTY.	1905.		
	GOLD.†	SILVER.†	TOTAL.†
Burke	$ 1,000	$ 15	$ 1,015
Cabarrus	22,836	53	22,889
Catawba	3,500	81	3,581
Davidson	1,000	420	1,420
Guilford	9,000	30	9,030
McDowell	500	10	510
Mecklenburg	4,200	12	4,212
Montgomery	61,000	1,600	62,600
Nash	2,000	6	2,006
Rowan	7,200	17,600	24,800
Stanly	10,000	140	10,140
Union	4,948	29	4,977
Unknown	1,969	220	2,189
Total	$129,153	$20,216	$149,369

As is seen from the above, the production of silver is obtained chiefly from Rowan County, which was the only county producing copper during 1905.

---

* The gold and silver statistics have been obtained through the courtesy of Mr. George C. Roberts, Director of the Mint, Washington, D. C. The counties given in this table do not represent all the producing counties, but the production has been given as far as possible to the principal producing counties and the balance is given as "Unknown." This latter undoubtedly includes a dozen or more counties.

† Coining value.

In the following table there is given the production of gold and silver in 1903 and 1904 by counties:

PRODUCTION OF GOLD AND SILVER IN 1903 AND 1904 BY COUNTIES.*

COUNTY.	1903			1904		
	GOLD.†	SILVER.†	TOTAL.†	GOLD.†	SILVER.†	TOTAL.†
Alamance	$----------	$----------	$----------	$ 23.26	$ .27	$ 23.53
Anson	----------	----------	----------	52.56	1.32	53.88
Burke	1,606.44	17.09	1,623.53	1,507.03	23.03	1,530.06
Cabarrus	3,237.23	85.93	3,323.16	14,889.80	193.08	15,082.88
Caldwell	41.10	.87	41.97	46.52	.41	46.93
Catawba	1,181.07	19.09	1,200.16	5,438.29	105.75	5,544.04
Chatham	----------	----------	----------	96.74	1.60	98.34
Cherokee	1,144.52	5.91	1,150.43	123.76	.74	124.50
Clay	46.51	.29	46.80	57.90	.36	58.26
Cleveland	5,269.40	1.16	5,270.56	180.47	4.46	184.93
Davidson	230.12	161.52	391.64	1,102.77	590.91	1,693.68
Franklin	162.79	2.48	165.27	88.37	1.86	90.23
Gaston	196.84	2.85	199.69	217.88	4.71	222.59
Granville	562.68	2,258.97	2,821.65	610.07	1,189.05	1,799.12
Guilford	3,806.62	159.16	3,965.78	12,853.11	46.16	12,899.27
Halifax	423.81	2.63	426.44	178.54	1.45	179.99
Henderson	186.05	2.33	188.38	32.31	.37	32.68
Iredell	133.84	1.60	135.44	162.20	2.51	164.71
Lincoln	522.42	9.90	532.32	35.03	.84	35.87
Macon	93.02	.58	93.60	46.52	.30	46.82
McDowell	2,260.15	30.60	2,290.75	602.78	14.10	616.88
Mecklenburg	8,578.72	102.89	8,681.61	1,157.99	25.04	1,183.03
Montgomery	48,634.83	878.27	49,513.10	50,460.88	901.46	51,362.34
Moore	388.87	8.04	396.91	310.46	7.04	317.50
Nash	139.54	2.15	141.69	44.18	.95	45.13
Orange	351.46	5.11	356.57	23.26	.15	23.41
Person	1,096.15	8,632.24	9,728.39	171.50	2,734.51	2,906.01
Polk	602.21	4.22	606.43	192.78	1.86	194.64
Randolph	396.30	6.96	403.26	397.62	12.99	410.61
Rowan	1,852.39	4,119.21	5,971.60	4,163.72	12,852.09	17,015.81
Rutherford	1,322.20	16.91	1,339.01	484.95	3.24	488.19
Stanly	24,524.30	116.05	24,640.35	17,113.65	157.32	17,270.97
Union	3,101.84	95.68	3,197.52	9,677.08	224.56	9,901.64
Warren	139.54	1.75	141.29	359.07	2.36	361.43
Unknown	1,370.59	154.22	1,524.81	1,020.95	25.73	1,046.68
Total	113,603.55	16,906.66	130,510.11	123,924.00	19,132.58	143,056.58

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* The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

† Coining value.

In the next table there is given the value of the gold and silver productions in North Carolina for the years 1882 to 1905, inclusive:

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1905.*

YEAR.	GOLD.	SILVER.	TOTAL.
1882	$190,000	$25,000	$215,000
1883	167,000	3,000	170,000
1884	157,000	3,500	160,500
1885	152,000	3,000	155,000
1886	175,000	3,000	178,000
1887	225,000	5,000	230,000
1888	136,000	3,500	139,500
1889	145,000	3,878	148,878
1890	118,500	7,757	126,257
1891	95,000	6,465	101,465
1892	78,560	12,671	91,231
1893	53,600	17,325	70,925
1894	46,594	455	47,049
1895	54,200	520	54,720
1896	44,300	646	44,946
1897	34,600	388	34,988
1898	84,000	905	84,905
1899	34,500	388	34,888
1900	44,653	15,986	60,639
1901	60,410	34,023	94,433
1902	93,650	30,212	123,862
1903	113,604	16,907	130,511
1904	123,924	19,133	143,057
1905	129,153	20,216	149,369

* Coining value.

COPPER.

PRODUCTION.

The production of copper in 1905 was all from Rowan County and amounted to 10,000 tons of ore, of which the value of the copper contents was $88,000. Reckoning the copper at 18 cents per pound, this makes the total copper production equal to 488,888 pounds. As compared with the production of 305,000 pounds, valued at $36,600, in 1904, this is an increase of 183,888 pounds in quantity and of $51,400 in value. All this ore was shipped to the smelters at Ducktown, Tennessee. In the following table there is given the production of copper in North Carolina from 1900 to 1905:

PRODUCTION OF COPPER FROM 1900 TO 1905.

YEAR.	CRUDE ORE MINED.	COPPER PRODUCED.	VALUE.
	Tons.	*Pounds.*	
1900	6,948	......	$ 41,600
1901	10,398	512,666	76,900
1902	16,741	1,417,020	212,553
1903	4,106	458,133	67,037
1904	4,250	305,000	36,600
1905	10,000	488,888	88,000

COBALT.

During the past 18 months there has been considerable interest aroused in North Carolina regarding the location of deposits of minerals containing the metal, cobalt, due to the fact that Mr. Thomas Edison made a personal trip through the State apparently with the object in view of locating commercial sources of supply of this metal.

Cobalt is a metal that is very similar in its properties to nickel, and, with few exceptions, all minerals in nature that contain one of these metals contain also a small percentage of the other. In the reduction of the ores containing nickel and cobalt, they both go into the matte, which is afterwards refined and the two metals separated from each other. The demand for cobalt is not large and there is usually an overproduction of this metal, which is obtained as a by-product from nickel ores. For this reason there has been but little direct prospecting for new sources of supply of cobalt. The demand for nickel, however, has constantly increased, so that prospecting has been carried on in many sections of the country for deposits of this metal. Up to the past two years all the cobalt produced in the United States and Canada was as a by-product either in nickel or lead mining and smelting, and there had been no direct mining for cobalt ores. Recently, however, new sources of supply of cobalt, containing but little nickel, have been found in Canada, which have resulted in the production of cobalt in some quantity, and this could be very largely increased if a sufficient demand should be created for this metal. These deposits are in Canada, on the line of Temiscuming and North Ontario Railroad, 90 miles northeast of Sudbury. These ores carry a considerable percentage of cobalt and are rich in silver, thus making the ore very profitable mining.

In the United States there has been no direct mining for ores of cobalt, and that which has been produced has been associated with the lead ores mined at Mine La Motte, Mo., which contained a considerable percentage of cobalt and a very small quantity of nickel. A matte is obtained which contains nickel, cobalt, and copper, and a small quantity of lead. This is afterwards refined and the nickel and cobalt separated out. The cobalt is put on the market in the form of cobalt oxide, which is worth approximately $1 per pound.

The principal use of cobalt is in the manufacture of pigments, the principal one being known as cobalt blue. Some experiments have been made with cobalt for use in the manufacture of a specially hardened steel, which is the principal use of nickel. There is not, however, distinct enough difference in the properties imparted to steel by these two metals to warrant the use of cobalt as a steel or iron hardening metal so long as its cost is so much higher than nickel. If, however, a special use can be devised for it in the manufacture of storage batteries, as has been reported to be advocated by Mr. Thomas Edison, there should be a considerable increase in the demand for the metal, which would warrant more prospecting for sources of supply, although the present known supplies of this metal can satisfy a very large increase in the demand.

There are a number of minerals, principally sulphides, arsenides, and oxides, that contain a considerable percentage of cobalt, the principal ones being as follows:

Linnæite.—This mineral, known also as cobalt pyrites, is a pale steel-gray brittle mineral, which tarnishes quite readily to a copper-red color. It is as hard as steel and has a specific gravity of about 5. It is a copper sulphide (Co_3S_4) and is quite commonly found in octahedral crystals, but also occurs massive.

Cobaltite.—This mineral, also known as tin-white cobalt and gray cobalt, is a cobalt arsenic sulphide ($CoAsS$) of a silver-gray to steel-gray color, sometimes having a tinge of red or violet. It is quite commonly found in pyritohedral crystals of silver-white color, and also occurs massive, when the color is apt to change to a steel-gray or a grayish color. It is as hard as steel and about 6.5 in specific gravity.

Smaltite.—This mineral has a tin-white to steel-gray color and is 5.5 to 6 in hardness, its specific gravity being about 6.5. It is brittle and commonly occurs massive. In composition it is essentially a cobalt di-arsenide ($CoAs_2$).

These minerals have not been found in any large masses, but are usually found more or less sparingly disseminated through rocks and associated in veins with other minerals. In decomposing or altering these would form carbonates, sulphates and oxides, which would be entirely different in appearance from the minerals from which they have been derived. The more common alteration product would be the oxide which is apt to be found largely mixed with other oxides, but very little having been found in the free state.

One of the common minerals with which cobalt oxide is associated is a variety of psilomelane, a manganese oxide, known as wad or bog manganese. In certain localities this wad or bog manganese contains considerable cobalt oxide and is then known as asbolite. These minerals all have an iron-black to steel-gray color resembling somewhat a soft amorphous variety of graphite, for which they have occasionally been mistaken.

Asbolite.—This mineral is also known as black cobalt, earthy cobalt, and cobalt oxide. Its appearance is as mentioned above and it sometimes contains as high as 32 per cent. of cobalt oxide. In North Carolina none of the sulphides or arsenides, the original metallic minerals of cobalt, have thus far been identified, but in a number of localities the oxide or asbolite has been observed associated with manganese minerals. The principal localities where this asbolite has been found are as follows: A few miles southeast of Cary, Wake County, where black manganese cobalt mineral can be observed for a quarter of a mile outcropping occasionally on the surface. A small amount of prospecting has been done here, consisting of pits and cuts on the vein, which have shown that it is probably continuous for at least a quarter of a mile. In Gaston County there is a belt of micaceous schist extending in a general N. 20° E. direction that can be traced from Bessemer City northeastward into Lincoln County. These schists contain throughout their whole area numerous small seams, incrustations and stains of black manganese materials, which give reactions for cobalt. Some of this material is largely iron oxide that has more of a reddish or yellowish ocher color. At the Ormond iron mine, one mile southwest of Bessemer City, there is a considerable quantity of this material found mixed with the iron ore, and it may be that it was the cobalt which went into the pig-iron, and gave it the hardness and toughness for which this iron was noted. At the Long Creek gold mine, situated about 6 miles northwest of Dallas, Gaston County, masses of the ore taken out of the Asbury shaft were thickly incrusted with mamillary masses of asbolite or earthy cobalt. About a mile northeast from the Long Creek mine, on the old Lincolnton-Yorkville (S. C.) road, near the summit of Cross or Peysour Mountain, a band of rock, about 15 feet wide, contains veins and seams of wad or asbolite. Following this vein in a northerly direction, it descends the west slope of Cross Mountain, and 50 years ago a number of openings were made on the asbolite seams. Some of this material was analyzed and gave 13.26 per cent of cobalt and nickel oxides, the larger amount being cobalt. The same formation can be traced in Lincoln County, where similar seams of wad are observed. The original minerals from which this cobalt oxide was derived may be one of the sulphides mentioned above, or some of the sulphides that contain both nickel and cobalt.

There are many other localities where psilomelane or wad has been found, but at the present time they have not been shown to contain cobalt. These are Scott's Hill, Burke County; near Lenoir, Caldwell County; at Gillespie, near Bakersville, Mitchell County; on Cove and Richmond creeks, Haywood County; near Buckhorn, Chatham County; near Murphy, Cherokee County; Franklin, Macon County; Webster, Jackson County; Zirconia, Henderson County; and Davidson River, Transylvania County.

The simplest test for cobalt is by fusing some of the powdered mineral with borax, the cobalt oxide giving to the resulting borax glass a deep blue color. This test is so delicate that it will show even traces of cobalt and can be used when a large percentage of nickel is associated with the cobalt.

IRON.

The iron deposits of North Carolina were not very extensively operated during 1905, and the only deposit that was a producer of this metal was the celebrated Cranberry mine at Cranberry, Mitchell County, which contains magnetic iron ore and furnishes a pig-iron of superior quality. A similar iron ore occurs in Ashe County and only its distance from railroad transportation prevents its being mined. There are other deposits of iron ore throughout the different counties of North Carolina that are not worked, principally on account of their distance from sources of fuel and flux, or their distance from railroad transportation. There are some deposits, however, favorably situated on the railroad, such as the Ormond mine, Bessemer City, Gaston County, which should make profitable mining, even though the ore has to be shipped a considerable distance by rail. With any advance in the price of iron the deposits in Cherokee, Jackson, Chatham, and Gaston counties would, undoubtedly, be worked, and the ore shipped to furnaces located at Bristol, Tenn., Birmingham, Ala., or elsewhere.

PRODUCTION.

The production of iron ore in North Carolina during 1905 amounted to 56,282 tons, valued at $70,352, and was obtained from Mitchell County. As compared with the production of 64,347 long tons valued at $79,846, the 1904 production, it is a decrease of 8,065 tons in quantity and of $9,494 in value. The Junaluska Iron Company of Andrews, Cherokee County, which produced a small amount of ore in 1904, reported no production in 1905. In the following table is given the production of iron ore in North Carolina from 1900 to 1905, inclusive.

PRODUCTION OF IRON ORE IN NORTH CAROLINA, 1900-1905.

YEAR.	AMOUNT LONG TONS.	VALUE.
1900	21,000	$42,000
1901	2,578	4,997
1902	34,336	52,771
1903	82,851	78,540
1904	64,347	79,846
1905	56,282	70,352

TIN.

There was no production of tin ore in North Carolina during 1905, but there was much prospecting and development work carried on, especially at Kings Mountain, Cleveland County; near Bessemer City, Gaston County; and near Lincolnton, Lincoln County. At the old Ledoux mine, at Kings Mountain, a mill with rolls, jigs, and tables was erected, and the company operating this plant expect to handle not only the ores from this mine, but from other tin deposits that are being opened up in the vicinity. A small quantity of concentrates have been obtained from this property, but none have been put on the market.

At the Jones mine, 7 miles north of Kings Mountain and 3 miles northwest of Bessemer City, a small roll-mill with two Bartlett tables was erected and a small amount of the ore treated. The concentrates, however, have not been shipped. The property has been worked to the 100-foot level, and some very good ore has been exposed. There has not, however, been any large amount of ore blocked out.

Perhaps the most extensive development work has been carried on near Lincolnton, Lincoln County, by the Piedmont Tin Mining Company. The property of this company begins about 2 miles southwest of Lincolnton and extends in a general southwest direction for 2 miles, to the Little Catawba River, about midway between Long Shoal and South Side, two stations on the Carolina and Northwestern Railroad. Tin-bearing pegmatite has been exposed at a number of places throughout this area, and has shown the existence of two or more approximately parallel pegmatitic dikes, which are also following the laminations of the schists and gneisses. There were other pegmatitic dikes also observed that were cutting the dikes referred to above and the lamination of the country rock. The company have acquired by purchase and lease control of a property about 2 miles long and 1 mile wide, which has been prospected more or less over its entire area.

The country rock of this section consists of hornblende and mica gneisses and schists that are intersected by the pegmatitic dikes, which sometimes are cutting across the strike of the schists and then again following it and at other times have sent off apophyses which have forced their way between the laminations of the schist and gneiss. Occasionally, a mass of the pegmatite is encountered that has all the appearance of a boss. These dikes are very variable in width from a few feet up to 30 or more. They have the usual mineralogical character of ordinary pegmatitic dikes, except that for the most part they are tin-bearing. The position of the tin in these dikes was carefully noted, and in nearly all cases it was observed that the main portion of the dike carried little or no cassiterite (tin oxide), but that this mineral was confined to restricted portions of the dike, which, in nearly all cases, was near the contact of the pegmatitic dike and country rock. In these areas there was usually but little feldspar, and the dike was made up largely of quartz and mica. Occasionally, where the pegmatitic dike was narrow, tin oxide was found scattered sparingly throughout the whole mass.

The work done by this company has made this section the most favorable one for studying the occurrences of these pegmatitic dikes and of the tin mineral which they contain. Beginning at the southwest end of the property, on a hill, just above the Little Catawba River, the company have sunk shafts and pits and made open cuts at various intervals from this point for a distance of 2 miles in a northeast direction to what is known as the Main Shaft mine, where the greater amount of underground work has been done. Wherever any pegmatitic dikes have been encountered in this prospecting, they have contained more or less tin oxide, but in very varying percentages. The work has also shown that the pegmatitic dikes are extremely variable in width, both on the strike and dip. There are two points, one known as the Henry shaft and the other the Main shaft, where considerable underground work has been done.

The Henry shaft, which is approximately 1 mile southwest of the Main shaft, is 60 feet deep, from the bottom of which a drift 30 feet long has been run in a N. 45° E. direction. In a distance of 18 feet this drift encountered a pegmatitic dike which proved to be 12 feet wide and had an approximate strike of N. 25° W. The main portion of this dike showed little or no tin oxide, but near its contact with the country rock tin oxide was encountered for a width of 1 to 2 feet. At the 45-foot level about 52 feet of drift has been run, which only showed a small amount of pegmatite at one point in the roof of the drift about 12 feet from the shaft.

At the Main Shaft mine, where most of the work of the company has been concentrated, two shafts have been sunk, one 102 feet deep and the other, which is 165 feet E. 12° S. from No. 1, is 40 feet deep, the two being connected on the 40-foot level. Near the mouth of the 40-foot shaft a pegmatitic dike was encountered near the surface and was followed on the surface for some distance in each direction by an open cut. In sinking this shaft pegmatite was encountered for only a part of its depth, and the foot of the shaft is entirely in the country rock. As far as can be determined, the pegmatite encountered in the shaft is simply an apophysis from the mass of pegmatite encountered on the surface, or else a small parallel dike. The 102-foot shaft has two levels, one at 40 feet and the other at 102 feet. From the 40-foot level the main drift is 198 feet 8 inches long and extending beyond the 40-foot shaft. From this drift cross-cuts aggregating 720 feet have been made. The larger proportion of the work done on this level is entirely within the country rock, and the cross-cuts are very circuitous in their courses. They have proved that the pegmatitic dikes, of which there are evidently a number, are irregular in their course and vary considerably in width, both along the strike and dip. A large portion of the drifts and crosscuts on this 40-foot level are entirely within the country rock and is partly due to the irregularity of the pegmatitic dikes. At a number of points throughout the crosscuts and drifts on this level, winzes have been sunk in some instances on a pegmatitic dike and in others to encounter a supposed one that was dipping under the drift or crosscut. These winzes aggregate 67 feet of depth, making a total of 1,177 feet of development work on this level.

From the bottom of the shaft on the 102-foot level drifts have been run east and west for a distance of 158 feet, from which 33 feet of crosscuts have been made, making a total of 191 feet of development work on this level. A pegmatitic dike a few feet in width was encountered in the west drift, which was followed by the crosscuts.

There has been a total of 1,319 feet of underground development work at this Main Shaft mine, and although this has exposed in a number of places pegmatitic dikes which carry more or less tin, it has not as yet developed or blocked out any large quantity of ore. The dikes show the same characteristics regarding the tin oxide as was observed in those examined on other parts of the property, namely, that the larger proportion of the tin oxide is concentrated near the contact of the pegmatitic dike with the country rock and usually in seams from a few inches to a foot in width.

Although there has been this comparatively large amount of work accomplished during the past year on the tin deposits of the State, it has not as yet proved conclusively the real value of the Carolina tin deposits. It has, however, demonstrated that to make these deposits profitable will require economical and careful management. The work has also shown that the percentage of tin in the narrow portion of the pegmatitic dikes, near the country rock, will run rather high, perhaps as much as 4 to 8 per cent of tin oxide; but as this portion of the dike will vary from a few inches to possibly 2 feet, it will reduce the percentage of tin oxide in the rock necessary to remove in mining to from a fraction of one per cent to perhaps 1½ per cent tin oxide. Although these percentages of tin oxide in the vein are small, yet with careful management and tin at 30 cents per pound, they could be worked at a profit. With tin at the price it has been selling for during the past year, 48 cents, the chances of profit are, of course, much larger.

Tin mining is a very attractive mining proposition, on account of the scarcity of the metal and the large demand for it in the United States, which imported during 1905, 44,188 short tons valued at $26,316,023, making an average price of 29.77 cents per pound. This is considerably below the price at which tin was sold in New York City during the year, which, to the middle of December, 1905, had reached 37⅜ cents per pound. During the early part of 1906 it had reached 48½ cents per pound. The reason for this rise in the price of tin has been that the consumption is largely in excess of the present supply, and stocks of tin that have been kept on hand have been consequently very materially diminished.

Although these high prices have stimulated prospecting for new sources of supply of tin ore, they have not resulted in locating any deposits capable of producing large quantities of this metal.

It is to be hoped that the future development work on the tin deposits in the Carolinas will be carried on in such a way as to block out bodies of ore which can be carefully sampled and their tin contents determined and a satisfactory method devised for saving the tin concentrates, provided the percentage of the tin mineral is high enough to warrant their being worked.

ABRASIVE MATERIAL.

The abrasive industry in North Carolina is not large, and since the closing down of the corundum mine at Cullasaja, Macon County, and the garnet mines at Sugar Loaf Mountain, Jackson County, the production of abrasives has been very small.

CORUNDUM.

Although there is a large demand for corundum, which the present supply does not begin to fill, yet there has been but very little activity in corundum mining in this State during the past year. One reason for this inactivity is the fact that the International Emery and Corundum Company of New York own three or four of the better corundum properties in the State, including the Corundum Hill and Mincey mines, Macon County, and the Buck Creek mine, Clay County. This company has not worked any of these properties since they came into their possession and, as far as can be learned, has no intention of working them, but will sell same if a satisfactory price can be obtained. On account, however, of the length of time since these properties were operated, no purchaser would be justified in paying any large amount for these properties without first having obtained an option which would give sufficient time to open them up and find out their present condition. There is, undoubtedly, still a large quantity of good corundum in the Corundum Hill and Buck Creek properties, which, if mined and cleaned properly, would find a ready sale.

The only two properties that are being actively operated are in Clay County, one being the old Behr mine located in Clay County, near Elf P. O., on Shooting Creek, 6 miles southwest of Haysville, the county-seat. The nearest railroad point is Murphy, Cherokee County, which is 26 miles northwest of this mine. It was first opened in 1880 by Dr. H. S. Lucas, but was soon afterwards bought by Herman Behr & Co., of New York. Several car-loads of cleaned corundum are reported to have been shipped, but the mine remained closed from 1890, until it was reopened during the past year by Major H. P. Dunlap of Asheville, N. C. The corundum has been opened in a mass of peridotite rock, which can be traced for a distance of a little over 2 miles in a N. E.-S. W. direction, and near the northeast extension of this long narrow mass of peridotite. The main mass of this rock, which has a maximum width of a quarter of a mile, is one-half mile southwest of the Behr mine. Cutting this peridotite are dikes of dark-green amphibolite. The main country rock through which these two rocks have penetrated is a hornblende-gneiss. Corundum has been found sparingly at a number of places in the mass of peridotite, but usually close to its contact with the gneiss. It has also been found in certain portions of the amphibolite. At the present time the work that has been done on this corundum deposit consists of a large oval-shaped cut or pit approximately 80 feet long, 36 feet wide and 45 feet deep. From the bottom of this pit an inclined (60°) shaft has been sunk to a depth of 30 feet, from the bottom of which drifts were run N. E. and S. W. At a depth of about 40 feet the corundum and peridotite were found to dip under the hornblende-gneiss at an angle of 60°, and conditions seem to indicate that a small block of gneiss has been enclosed by the peridotite, which may have influenced the greater separation of corundum at this particular point. Thirty-six feet northwest of the inclined shaft is a vertical shaft started from the surface which has been sunk to a depth of 90 feet. At the 75-foot level a drift was run S. E., encountering, in a distance of 30 feet, the corundum vein which had been worked in the old inclined shaft. The bottom of this 90-foot shaft, which could not be seen on account of its containing water, was reported as still being in barren peridotite rock. The old drifts from the incline were so badly caved in that it was impossible to re-examine them. The vein, however, where it was cut by the drift from the vertical shaft was examined, as was also all sides of the open cut and pit, but only a small amount of corundum was observed This property is still being worked and giving employment to about six men.

To the north of the Behr mine, and across the mountain, is one of the most important corundum localities in North Carolina, which is known as the Buck Creek region, where the corundum is associated with the largest compact peridotite area in the State. The locality is in the narrow Buck Creek valley, about 20 miles southwest of Franklin, Macon County, and 21 miles northeast of Haysville, Clay County. The property, which includes the main mass of this peridotite formation, is owned by the International Emery and Corundum Company of New York, referred to above.

Near the northwestern end of this peridotite mass, where it is much narrower than the main mass, is the mine of the North Carolina Corundum Company, of Detroit, Michigan. The corundum has been found in a number of small veins of almost massive corundum, 3 to 6 inches thick. The company has erected a large mill for cleaning the corundum and a small amount of the cleaned product has been shipped. The property has not been operated very extensively during 1905, and for a considerable part of the year was shut down.

There has recently been published by the Survey a volume[*] on Corundum and the Peridotites of Western North Carolina, by Joseph Hyde Pratt and Joseph Volney Lewis, of which the following is a short review.[†]

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[*] Copies of this volume can be obtained by writing Joseph Hyde Pratt, State Geologist, Chapel Hill, N. C., and enclosing 35 cents for postage, or 75 cents if a cloth-bound copy is desired.

[†] Journal of the Elisha Mitchell Sci. Soc., Vol. 22, 1906, p. 8.

Under the above title, Volume I of the North Carolina Geological and Economic Survey Reports has recently appeared. The scope of the work, however, is broader in many ways than this title indicates. It is a volume of 464 pages, and is illustrated by 45 plates and 35 figures in the text. While the report is the result of collaboration, the work has been divided so that, in the main, the mineralogical investigations have been conducted by Dr. Pratt, and the petrographical study of associated rocks has been the work of Professor Lewis. The preface states: "To only a limited extent have the authors been able to carry on field work together. The work for the most part has been done at different times, each working independently. Notwithstanding this fact and the somewhat different methods employed, each has been led to essentially the same conclusions in the interpretation of field observations. Especially is this true in regard to the theories of the origin and present relations of both the peridotites and the corundum."

A brief sketch of Geology of the State is given in Chapter I, with a somewhat fuller description of the belt of gneiss, granites and schists, constituting the mountain section of the west, and in which the peridotites and the corundum deposits of the State occur.

Chapter II deals with the peridotites and associated basic magnesian rocks, including four varieties of peridotites, four pyroxenites, four gabbroic rocks, an amphibolite, and three varieties of diorite. These are chiefly well-known types, with the exception of the pyroxenite, composed of the orthorhombic pyroxene, enstatite. This rock is somewhat commonly found throughout the region and forms many masses of considerable extent. The name *enstatolite* is proposed for this type, in conformity with the terms bronzitite and hypersthenite. These rocks are discussed in their relations to the belt of similar rocks, which extends the whole length of the eastern crystalline belt, from central Alabama through Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, the New England States, Quebec and Newfoundland.

Maps are given showing the distribution and relations of these rocks to the crystalline rocks in eastern North America and western North Carolina, besides several detailed maps of various portions of the belt of particular interest. The contoured map of western North Carolina is on a scale of eight miles to the inch, with the base printed in three colors, after the manner of the maps of the United

States Geological Survey. On this the "Conglomerates, quartzites, slates, etc., chiefly 'Ocoee,' correlated with Cambrian by the United States Geological Survey," and the "Gneisses, schists, granite, diorites, and other crystalline rocks of pre-Cambrian age," are clearly represented by tints, while the numerous dikes of peridotites and related rocks and the occurrences of corundum, chromite and asbestos, are shown in bright red.

The petrographic descriptions which constitute Chapter III are illustrated by half-tone reproductions of photomicrographs, showing the mineralogic and structural variations and modes of alteration of the rocks described. Following the general descriptions of these rocks throughout the Appalachian region, the distribution and petrographic characters are given in considerable detail for western North Carolina.

In addition to the numerous facies of primary rocks, secondary types are also described, including those mechanically derived from the primary types, now represented by gneisses, schists and gabbro-diorite, and also a series of hydrous alteration products, including serpentine, steatite, and chloritite (chlorite rock). The vast majority of occurrences of these basic rocks, while showing more or less alteration, are essentially fresh primary types, especially the pure olivine-rock, dunite, which is much the most common. Steatite is pretty widely distributed as an alteration product, but massive serpentine is almost entirely confined to an area extending about 15 miles north and south of the French Broad River. Even in these cases, however, the origin of the serpentine from peridotites of exactly similar character to those found in adjoining regions is very evident.

Chapter IV takes up the modes of alteration and decomposition of the peridotites, and five distinct processes are recognized: 1. Weathering; 2. Serpentinization; 3. Steatitization; 4. Chlorotitization; 5. Amphibolization. The processes of weathering and serpentinization are well-nigh universal, though developed only to a slight extent, except in a few localities. Alterations to talc, chlorite and amphibole are much more limited in their manifestations, but have given rise to many important rock masses. The various processes as affecting the peridotites of diverse composition are described minutely.

The long-vexed question of the origin of peridotites is taken up in Chapter V. The strong trend of modern thought toward the theory of igneous origin is clearly brought out, and the correctness of this theory is abundantly substantiated by observations in North Carolina. The data presented upon this point are arranged under five heads: 1. Mineralogic characters; 2. Microscopic characters; 3. Gross structures; 4. Modes of occurrence; 5. Relation to the gneisses and schists. This is followed by a discussion of the general petrology of the peridotites and associated rocks in which the conception of genetic unity of the whole series is strongly emphasized.

It is pointed out, as a noteworthy fact, that many of these rock types are closely associated in almost every occurrence throughout the crystalline belt of eastern North America. Usually, one or another type preponderates in any particular region, but the associations are always essentially the same. Thus the peridotites, particularly dunite, prevail in North Carolina and Quebec, the pyroxenites in Pennsylvania, and the gabbros are very abundant in Delaware and Maryland. In fact the types represented in the various regions are almost identical, and the petrology is closely similar, except in relative abundance of the various types, and in degree of alteration.

In discussing the magmatic relations of the peridotites, anorthosites, amphibolites, etc., two generations of corundum are recognized. The greater part, including all deposits of commercial value, belongs to the first generation, and was formed by the crystallization of the excess of alumina in the original peridotite magma. A very small part, however, occurring in microscopic grains, has been produced by an excess of alumina arising from the corrosion of anorthite by the still molten magnesia magma. This process has produced the sheaths of intermediate minerals which form the *corrosion mantles,* so beautifully developed in some localities, or which, in some cases, entirely replace the anorthite or the olivine, as the case may be, with nest-like aggregates.

Regarding the age of the peridotites, the conclusion of the present writers may be summarized as follows: Sufficient data are not yet available for a satisfactory determination of the age of these rocks, but their intrusion was probably contemporaneous, or practically so, for the whole region from Newfoundland to Alabama. The peridotite belt lies in a region of great disturbance and intense metamorphism. This fact, together with the geological relations to the northward, suggests the hypothesis that the principal period of intrusion was closely associated with the orogenic movements which closed the Lower Silurian (Ordovician) period. The distribution of these rocks may well mark to a great extent the axis of most intent folding and faulting. The latter Appalachian disturbances, at the close of the Carboniferous, have produced the lamination so often seen in these rocks, and have probably given occasion for later minor intrusions. This hypothesis is not offered as a final answer to the question of age of the peridotites. Much painstaking work yet remains to be done before an entirely satisfactory solution of this problem can be expected.

The chapter closes with a discussion of the relations of the secondary rocks, in which the attempt is made to trace the various laminated and hydrated alteration products back to their original types. Here the question is reached, whether the amphibolites, diorites, hornblende-schists, and hornblende-gneisses may not themselves have been derived from corresponding pyroxenite types, such as are met with in the Maryland and Delaware gabbro areas. The fact is pointed out that undoubted gabbro-diorites do exist in portions of the belt in North Carolina, and hence it is considered probable that many, if not all of these rocks, as well as similar rocks throughout the region, have had a like origin.

After a discussion of the physical and chemical properties of corundum in Chapter VI, is given a description of the various applications of the mineral in the arts, and an outline of the process of manufacture of the several types of corundum and emery wheels on the market.

Chapter VII deals with the modes of occurrence of corundum. In North Carolina the mineral is known in five types of igneous rock, namely, peridotite, pyroxenite, amphibolite, anorthosite, and pegmatite; in six metamorphic rocks, serpentine, gneiss, mica-schist, quartz-schist, amphibole-schist, and chlorite-schist. It is also found in gravel deposits of emery, whose relations are undetermined. These modes of occurrence are described in detail, and are compared with similar occurrences, when known, in other parts of the world. The deposits which have been of chief commercial importance in North Carolina have been associated with peridotites, and to a less extent with pyroxenites and amphibolites. The gravel deposits are of considerable interest on account of the corundum gems (ruby) and associated garnet gems (rhodolite) that have been found in some of them.

With the peridotites the corundum occurs chiefly in "peripheral or border veins," striking along the borders of many of the massive outcrops, and in "interior veins," extending from the borders at greater or less distance toward the center of the peridotite masses. In the pyroxenite and certain of the amphibolite occurrences the mode is similar. In other amphibolites the corundum is irregularly distributed in grains and larger plates and nodules through portions of the rock. Certain small pegmatite dikes, accompanying and penetrating both the peridotite and amphibolite, are found also to carry corundum. The corundum-bearing serpentine, amphibolites, and chlorite-schists are simply alterations of some of the foregoing types, with more or less dynamic disturbances and rearrangement of materials. Corundum-bearing belts of the gneisses and mica-schists, which sometimes pass into quartz-schists, have no apparent or probable relation with the peridotites, although occurring in the same region, and in some cases near the outcrops of these rocks.

The chief localities of corundum-bearing peridotite are in Clay, Macon, and Jackson counties, in the southwestern corner of the State, and most of the corundum-bearing gneisses, etc., are also found in the same counties. Certain scattered occurrences of corundum in amphibolite dikes and also in the gneisses are found east of the mountains, particularly in Iredell County.

"Other occurrences of corundum in America" extends the list of corundum-bearing igneous rocks to include granite, syenite, nepheline-syenite, Plumasite, norite, andesite, and monchiquite and adds crystalline limestone to the list of metamorphic corundum-bearing rocks. A brief description of each of these modes of occurrence is given with references to the literature of those that have been previously described. An additional list of "Modes of occurrence of corundum not found in America" adds to the number of corundum-bearing igneous rocks, kyschtmite tonalate, gabbro, quartz-porphyry, trachyte, and basalt, besides contact-zones and inclusions in igneous rocks. To the metamorphic list are added corundum schists and porphyroids and graphite. These are followed in turn by brief descriptions, completing the list to date of all known modes of occurrence of corundum throughout the world.

The distribution of corundum is described in Chapter VIII. Like the peridotites, this is treated first with reference to the Appalachian belt as a whole, noting the occurrences in Alabama, Georgia, South

Carolina, North Carolina, Pennsylvania, New Jersey, Connecticut, and Massachusetts. Corundum in the western part of the country includes descriptions of occurrences thus far known in Montana, Colorado, and California. This is followed by a description of the North Carolina localities in detail, arranged by counties, beginning in the southwestern corner of the State. The chapter closes with the description of foreign corundum and emery deposits, including those of Canada, India, Turkey, and the Grecian Archipelago.

Chapter IX deals with the alteration of corundum and its associated minerals in great detail. The list of minerals found associated with corundum in North Carolina includes 62 species, each of which is described, with its mode of occurrence, and its relations to the occurrence of corundum. Many have chemical analyses and crystallographic characters also given. "Minerals associated with corundum not found in North Carolina" adds 12 more to this list, from various American and foreign localities.

The difficult question of the origin of corundum is discussed in Chapter X. This is prefaced by an account of the artificial production of corundum, and the origin of corundum in nature is introduced by a sketch of the various hypotheses that have been proposed during the last quarter of a century. After a discussion of the field relations and the later experiments in the production of artificial corundum, the conclusion is reached that the corundum was held in solution in the molten magma of the peridotite when it was intruded into the country rocks, and that it separated out among the first minerals segregated as the mass began to cool. The conclusion is also reached that the corundum in the quartz-schists and gneisses is the result of metamorphism of sandstones and shales, some of which were rich in alumina, perhaps in the form of bauxite, which, during metamorphism, crystallized out as corundum.

Chapter XI deals with corundum mining and milling. It is introduced by a historical sketch of corundum mining in the East, followed by a sketch of mining in America. "Suggestions to prospectors," and methods of mining and milling, as carried out at various plants, conclude the chapter.

Chapter XII discusses the chromite and other economic minerals of the corundum-peridotite belt. Chromite in promising quantities has been found at a number of the peridotite localities in western North Carolina, particularly in Jackson and Yancey counties. Its origin and relations are discussed and the conclusion reached is essentially the same as for the origin of corundum in peridotites. A discussion of the chemical composition of chromite and its uses, and a description of the chromite localities of the region, with a summary of occurrence in other parts of the world, follow. The distribution and character of asbestos, nickel ores, serpentine, and limonite—minerals which, thus far, are of minor importance in the region—closes the chapter.

An appendix, consisting of a bibliography of American peridotites, and corundum and associated minerals, is not complete, perhaps, as regards the whole of North America, but is believed to be practically complete for North Carolina and the eastern crystalline region in general. There are also many references to foreign literature in foot-notes throughout the work, and the volume is closed with an elaborate index.

GARNET.

The demand for garnet for abrasive purposes is not very large, and the total amount produced in the United States since 1900 has varied from approximately 3,200 to 5,000 tons per year. There are many localities in North Carolina where garnet occurs in commercial quantity, but some of these are non-productive, on account of their distance from railroad transportation; others, which were formerly productive mines, have been shut down, but for what cause it is not known. The Sugar Loaf mine in Jackson County produced a quality of garnet for which there was considerable demand at a price higher than that paid for any other garnet on the market. The cost of production of this garnet was somewhat in excess of preparing most garnet, but the quantity of raw material is large and it could be put on the market in most any quantity desired. This property, however, was not operated at all during 1905.

The garnet deposit on Little Pine Creek, near Marshall, Madison County, produced a small amount during the past year.

A new, though small, source of supply of this mineral should be the garnet sand separated from the monazite concentrates obtained in mining this latter mineral in Burke, Iredell, Cleveland, and other counties in North Carolina. These concentrates sometimes contain as much as 20 per cent or more of garnet which is in the form of grain that has been rounded but very little, often having the appearance as though it has been crushed. A very clean separation of the garnet from the other minerals can be made on the Wetherill magnetic separator, and, as this mineral would be a by-product, it could readily compete with any garnet on the market. The product would be of exceptional purity and the garnet would have a hardness equal to any garnet that is now being mined.

MILLSTONES.

Buhrstones, or millstones, are usually manufactured from a stone that varies from a sandstone to a quartz conglomerate. In North Carolina, however, buhrstones are being made from a granitic rock which occurs at Faith, Rowan County, and thus far wherever used have given perfect satisfaction. The general demand for millstones or buhrstones has been increasing during the past few years for use in grinding cereals, mineral paint ores, fertilizers, cement rock, barytes and other minerals, and for these purposes the Rowan stone should give good satisfaction. There was, however, a falling off in the production of millstones in 1905.

PRODUCTION OF ABRASIVES.

There were only five producers of abrasive materials in North Carolina. Of these, three were millstones and one each of garnet and corundum. The combined production of garnet and corundum in 1905 amounted to 115 tons, valued at $9,000, as compared with 202 tons, valued at $6,586, in 1904. This shows a decrease of 87 tons in quantity, but an increase of $2,414 in value. This is due to the larger quantity of corundum mined in 1905 as compared with that of 1904, and a very large decrease in the quantity of garnet sold. There were 196 pairs of millstones valued at only $2,652 produced in 1905, as compared with 208 pairs valued at $6,500 in 1904. The quantity produced in these two years is almost equal, but the value of the 1904 production is over twice that of the 1905 production, due to the lower price of millstones and to the larger number of smaller stones made as compared with the previous year.

The total value of all abrasive materials produced in 1905 is $11,652 as compared with $13,086, the value of the 1904 production, a decrease of $1,434. The production of abrasive materials from 1901 to 1905 inclusive is given in the following table.

PRODUCTION OF ABRASIVE MATERIALS, 1901-1905.

YEAR.	CORUNDUM.		GARNET.		MILLSTONES.		TOTAL VALUE.
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	
	Tons.		*Tons.*		*Pairs.*		
1901	325	$ 48,840	775	$ 43,000	--------	$--------	$ 91,840
1902	--------	--------	260	10,040	50	1,425	11,465
1903	--------	--------	*403	12,250	63	902	13,152
1904	--------	--------	*202	6,586	208	6,500	13,086
1905	†1,150	9,000	--------	--------	196	2,652	11,652

MICA.‡

PRODUCTION.

Mica is one of the minerals for which North Carolina is especially noted, and of the total production of this mineral in the United States, North Carolina produces approximately four-fifths of the entire production. North Carolina mica is known as the standard mica and is the finest grade of mica on the market, and for those purposes where a sheet mica is desired, as for stoves, lamp-chimneys, etc., it cannot be surpassed. During 1905 the production of plate or sheet mica was 1,044,800 pounds valued at $100,900, this being an increase of 434,679 pounds in quantity, but only of $276 in value as compared with the production of 610,121 pounds valued at $100,724 in 1904. This large increase in the quantity of mica produced, with comparatively no increase in the value, is due to the much larger production of small disks and rectangular sheets that are used so largely for electrical purposes. The scrap mica produced in 1905 amounted to 275 tons valued at $3,375, an average of $12.27 per ton. As compared with the production of 1904, of 341 tons valued at $3,410, this is a decrease of 66 tons in quantity, and of $35 in value. There is given in the following table the approximate value and distribution of the production of sheet mica by counties for the years 1900 to 1905 inclusive.

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* Including production of corundum.

† Including production of garnet.

‡ For a more detailed discussion of mica, see reports for 1901 and 1904, Economic Papers 6 and 9 respectively.

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900 TO 1905, BY COUNTIES.

COUNTY.	1900.	1901.	1902.	1903.	1904.	1905.
Ashe	$----------	$----------	$----------	$ 1,000	$----------	$----------
Buncombe	----------	----------	250	300	----------	----------
Caldwell	----------	----------	----------	----------	10,000	----------
Haywood	11,000	11,500	20,000	18,000	34,500	33,710
Jackson	7,000	8,740	5,700	5,500	924	7,900
McDowell	1,000	500	600	1,000	----------	----------
Macon	5,200	----------	4,000	3,500	----------	1,500
Madison	----------	----------	----------	----------	----------	90
Mitchell	26,722	33,506	28,203	29,000	21,500	17,950
Stokes	1,000	----------	1,000	7,500	----------	----------
Transylvania	500	600	750	500	----------	600
Watauga	----------	----------	----------	----------	----------	350
Yancey	12,788	25,003	21,150	20,000	34,000	38,800
Total	65,200	79,849	81,653	86,300	100,724	100,900

QUARTZ (FLINT).

The quartz considered under this head is vein quartz, which is used for a variety of purposes, such as in the manufacture of pottery, for packing, for fluxing purposes, as an abrasive material, manufacture of scouring soaps, as a wood-filler, and in the manufacture of glass. In North Carolina the only flint that has been mined has been for fluxing and packing purposes.

During 1905 quartz was mined in Cherokee County for fluxing purposes, being used by the Tennessee Copper Company in their copper furnaces at Ducktown, Tenn. The Oliver mine in Mecklenburg County produced considerable quartz which was used for packing purposes. With the establishment of potteries in North Carolina there should be a considerable demand for quartz to be used for this purpose. Besides the above quartz, there is a great deal of quartz sand that is used in the manufacture of brick and other clay products, which, however, is not treated under this head, but is taken up under the head of Sand.

PRODUCTION.

The total production of quartz during 1905 was 32,648 tons valued at $13,659 as compared with 32,972 tons valued at $36,269, the production of 1904. This is a decrease of 324 tons in quantity and of $22,610 in value. This large falling off in value is due to the low value accredited to the production from Cherokee County used for fluxing purposes. This value was but little over 30 cents per ton. In the table below is given the production of quartz in North Carolina for the years 1901 to 1905 inclusive.

PRODUCTION OF QUARTZ IN NORTH CAROLINA, 1901-1905.

YEAR.	QUANTITY.	VALUE.
	Tons.	
1901	3,000	$ 7,500
1902	4,500	11,250
1903	29,462	36,827
1904	32,972	36,269
1905	32,648	13,659

BARYTES.

PRODUCTION.

The production of crude barytes in North Carolina during 1905 amounted to 5,544 tons valued at $21,670. This production is a decrease of 7,869 short tons in quantity and of $12,260 in value as compared with 13,413 short tons valued at $33,930, the production of 1904. The average value per ton received for the 1905 production was $3.91, which is $1.38 more than the average value, $2.53 per ton, of the 1904 production. The value received for the North Carolina barytes represents the crude mineral that has been mined and handcobbed ready for shipment to the mill, but without its being subjected to any other cleaning process. This production was obtained from Madison and Gaston counties, with by far the larger amount from the former county. In the following table there is given the production of barytes in North Carolina for the years 1901 to 1905 inclusive:

PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA, 1901-1905.

YEAR.	QUANTITY, SHORT TON.	VALUE.
1901	6,890	$20,865
1902	14,679	44,130
1903	6,835	21,347
1904	13,413	33,930
1905	5,545	21,670

MONAZITE AND ZIRCON.*

INTRODUCTION.

During the past five years there has been a considerable advance made in the manufacture of various forms of apparatus for lighting purposes. These investigations and inventions have led to the practical introduction of certain metals and metallic oxides into the arts which before this time had little or no commercial value. With the demand for these metals and metallic oxides there at once arose the question of their sources of supply, which has resulted in the mining of a number of minerals that were formerly supposed to be extremely rare in their occurrence, but which have now been found in considerable quantity. Experiments are being carried on with still other metals in regard to their usefulness for the manufacture of various incandescent and electric lamps.

The metals and the metallic oxides that are now being used and experimented with are tantalum, tungsten, cadmium, zirconia, thoria, yttria, and cerium, lanthanum, and didymium oxides. With the exception of cadmium, all these materials are being used commercially in the manufacture of different lamps and are obtained from the following minerals: Monazite, zircon, gadolinite, columbite, tantalite, wolframite, and hübnerite. These minerals and their occurrences have been described in detail in the reports for 1903 and 1904. The use of cadmium for lighting purposes is still in the experimental stage, and, although cadmium lamps have been made, they are still principally of scientific interest. As far as is known, no cadmium lamp has been made that would have a practical commercial value.

Of these minerals that now have a commercial value, monazite, zircon, and columbite have been found in North Carolina, and the two former are at the present time found in greater quantity in this State than in any other.

MONAZITE.

The demand for the mineral monazite, which contains the oxides used in the manufacture of mantles for the Welsbach and other incandescent gaslights, is constantly increasing, and many inquiries have been received during the past year for information regarding the source of supply of this mineral, not only for domestic, but also for foreign consumption. Although monazite has been found sparingly at many localities throughout the United States, the Carolinas are still the only States that are producing this mineral commercially; and by far the larger amount is produced in North Carolina. During 1905, however, a probable new source of supply of this mineral has been worked out by the investigations that have been carried on at the concentrating plant of the United States Geological Survey at Portland, Oregon, which has been testing systematically the black sands of the Pacific slope as to their mineralogical contents. The results of this investigation have shown the presence of some monazite and more zircon in many of these sands, especially in those from Oregon and Idaho. By using the Wetherill magnetic separator an almost perfect separation can be made of both the zircon and monazite. The results of this investigation of the black sands will be published in detail as a bulletin of the United States Geological Survey and will give the various localities where monazite has been found in the sands, and its percentage.

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*U. S. Geological Survey, pamphlet Mineral Resources, 1905.

In the Carolinas the monazite districts have been pretty thoroughly bounded, but occasionally a new section is discovered showing a sufficient quantity of monazite to make mining profitable, and thus extending the boundary slightly. In Greenville County, S. C., in the vicinity of Lenneman, in Grove Township, considerable monazite has been found in the creeks and branches, and during the past year some of this material has been shipped.

An interesting occurrence of monazite has been found in Queensland.* It has been known for some time that monazite occurs sparingly in the beach sands on the coast of Queensland, and that probably the most promising deposits are near the mouths of the Tweed and the Johnstone rivers. These deposits have not as yet been proved to contain this mineral in commercial quantities. The finding, however, of the monazite in these sands has led to further search which resulted in locating monazite in the original rock in two localities, namely, the Walsh and the Tinaroo mineral fields. Regarding these Mr. Dunstan says:

> The monazite was observed to occur in pure crystalline masses, sometimes several pounds in weight, and also in small cleavable grains. Both forms are irregularly disseminated in quartz, black mica (biotite), and chlorite mica, and are in association with wolframite, molybdenite, scheelite, tinstone, and mispickel.

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*Dunstan, B., Acting Government Geologist, Mining World, August 26, 1905.

With the exception of wolframite, these associated minerals are only in comparatively small quantities. The deposits containing the monazite are in granite country, but close to quartz-porphyry and slate. In the granite, and also at the junction of this rock with the porphyry and slate, irregular masses of greisen have been formed from the alteration of the granite, and it is in this, following closely the behavior of the wolframite, that the monazite deposits are to be found.

It is not improbable that the monazite in these deposits may become of commercial value, especially as it could be obtained as a by-product in mining the wolframite ore.

An interesting mineral, thorianite, was discovered early in 1905, associated with corundum, zircon, tin, topaz, spinel, etc. The mineral was first found by Mr. W. D. Holland in the refuse from gem washing near Balangoda, Ceylon, and was supposed to be uraninite or pitchblende, but upon analysis it was found to contain a very large percentage of thoria. The analysis of the mineral is as follows:*

Analysis of Thorianite.

Thorium oxide	76.22
Cerium, lanthanum, and didymium oxides	8.04
Zirconium oxide	Trace.
Uranium oxide	12.33
Ferric oxide	.35
Lead oxide	2.87
Silica	.12
	99.93

The specific gravity of the mineral is given as 9.32, and it was observed in black cubical crystals, which are fairly hard and give a brown streak. According to Mr. W. F. Peterd† the powdered thorianite dissolves readily in dilute sulphuric as well as in nitric acid. It has also been shown to be highly radio-active because of its uranium contents.

It is not improbable that this new mineral may be found in certain localities, in North Carolina, where tin, topaz, zircon, and monazite are found. According to the reports on this mineral, it is one that could be more easily utilized as a source of thoria than monazite, and as it has a much higher percentage of this compound it would be much more valuable.

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* Dunstan, Wyndham R., Ceylon Mineral Survey No. III; Mining Engineering (London), March, 1905, and Min. Mag., May, 1905.

† Min. World, Sept. 16, 1905.

In view of the large increase in the production of monazite in 1905 as compared with that of 1904, of the new companies organized that require thoria in their manufactured products, and of the inquiries that have been received from abroad, any deposit that contains monazite or any other thoria mineral in apparent quantity is worthy of careful investigation.

TANTALUM MINERALS.

The tantalum minerals are in demand on account of their containing the metal tantalum, which is used at the present time only in the manufacture of very fine wire for use in the construction of what is known as the tantalum lamp. Both the occurrences of the tantalum minerals and the tantalum lamp were described in detail in the report for 1904, and much has been written regarding the lamp in various scientific and commercial magazines during 1905, indicating its successful commercial use. In a recent paper read at the electrical convention in Denver and published in part in the *American Inventor,** Dr. Louis Bell makes the following statements regarding the value of this lamp:

> The mean result of various tests of lamps were: From clear globes, 22.2 candlepowder at 1.85 watts per candlepower, and from frosted globes, 19.08 candlepower at 2.1 watts per candle. It is interesting to note that the clear lamp gives just about one candlepower per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 candlepower per square inch of filament—a figure much higher than in the ordinary incandescent. As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator. Putting aside all the petty questions that will be raised about the new lamp for commercial reasons, the broad fact remains that we are here dealing with a *bona fide* 2-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these, socket by socket, and not as a substitute, with particular requirements, as in the case of the Nernst lamp, or the very small arcs. There is some doubt as to the life of the tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the every-day work of the central station there is good reason to believe it generally applicable.
>
> Its price can hardly be said to be fixed in this country, but abroad, in Berlin, it is about $1 (four marks), which will give at least a fair line on its commercial results. On this basis, and with power at 10 cents per kilowatt hour, one finds, taking the new lamp on its 600-hour rating, that the cost of its 12,000 candle hours, including the lamp, amounts to $3.40. The same number of candle hours from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90,

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* American Inventor, July, 1905.

exclusive of lamps; that is, the consumer could afford to pay $1 for the new lamp better than to take the old ones free. With power as low as 5 cents per kilowatt-hour, the user of tantalum lamps could afford to pay only 75 cents per lamp, as against getting carbon lamps free. This means that a sliding scale of discounts for lamps according to quality could be made to catch the consumer at all prices ordinarily charged for current by central stations.

The writer has examined a number of tantalum lamps and used some for a short time. The light is nearly white, like the Nernst or the acetylene light, and quite agreeable, though it will usually be found too bright unless a ground glass or frosted globe is used. It was noticed that there was more or less tendency for the tantalum filament to snap or break when subjected to an unusually great vibration, especially after the lamp had been used for some time. This difficulty, however, will very probably be overcome with further experiments as the lamp is more fully perfected. As yet it has not been introduced to any great extent in this country, but as it becomes better known it will undoubtedly have a large use. The tantalum lamp does not require any new fixtures, as it fits any socket in which the ordinary incandescent carbon lamp is used.

Although columbite has been found at a number of localities in Mitchell and Yancey counties, there has not been any production of this mineral.

ZIRCON.

This mineral is mined for its zirconia content, which is used, together with yttria and other rare earth oxides, in the manufacture of the glower for the Nernst lamp. At the present time North Carolina is the only State producing zircon commercially.

PRODUCTION.

During 1905 the total production of monazite in North Carolina was 894,368 pounds valued at $107,324. This is an increase of 208,369 pounds in quantity and of $27,886 in value as compared with 685,999 pounds valued at 79,438, the production of 1904. The above quantities in each case represent the cleaned sand containing from 85 to 99 per cent monazite. This production was obtained from the following counties: Burke, Cleveland, Lincolnton, McDowell, and Rutherford.

The 1905 production of zircon amounted to 8,000 pounds valued at $1,600, and was obtained from Henderson County. This makes the total production of these minerals mined for use in the manufacture of various lighting apparatus amount to 902,368 pounds in quantity and valued at $108,924. There is given in the table below the production and value of monazite and zircon mined in North Carolina from 1893 to 1905 inclusive:

PRODUCTION OF MONAZITE AND ZIRCON IN NORTH CAROLINA FROM 1893 TO 1905.

YEAR.	MONAZITE.		ZIRCON.	
	POUNDS.	VALUE.	POUNDS.	VALUE.
1893	130,000	$ 7,600		
1894	546,855	36,193		
1895	1,573,000	137,150		
1896	30,000	1,500		
1897	44,000	1,980		
1898	250,776	13,542		
1899	350,000	20,000		
1900	908,000	48,805		
1901	748,736	59,262		
1902	802,000	64,160	2,000	$ 380
1903	773,000	58,694	3,000	570
1904	685,999	79,438	1,000	200
1905	894,368	107,324	8,000	1,600

TALC AND SOAPSTONE.

The mining of talc in North Carolina represents one of the more important mining industries in the State and one grade of talc which is obtained from the Hewitt mine in Swain County is as fine a quality of talc as is produced anywhere. The demand for this particular talc is far beyond the supply and inquiries are constantly being received asking for information regarding new sources of supply similar in quality to the Hewitt talc. This talc is used in the manufacture of tailor's pencils, boiler-maker's pencils, gas tips, etc. Talc suitable for grinding into powder for use in the manufacture of talcum powders, soaps, etc., occurs quite extensively in both Swain and Cherokee counties. Pyrophyllite and compact talc or soapstone steatite is mined to a small extent and used, after being ground to a powder, for foundry facings, in the manufacture of paper, etc.

With the exception of a small amount of compact talc or soapstone that is quarried in the mountain counties and used for fire-places, chimneys, etc., there is none of it used for manufactured articles, such as tubs, table-tops, griddles, etc. This is due principally to the lack of railroad facilities. Soapstone deposits that are worthy of notice and that may prove of value when railroad transportation reaches them are located about 2 miles west of Beaver Creek, Ashe County. At several places quarries have been opened and good material obtained for local use in fire-places, etc. The individual deposits are lens-shaped masses, with a thickness up to several feet long in the enclosing schists, or associated with partially altered peridotite rocks. These lenses show very few fractures or joints, and some are capable of yielding tough, good-sized blocks or slabs. The soapstone saws readily, even though it carries a considerable quantity of only partially altered asbestiform tremolite.

The demand for talc for grinding and also for cutting into pencils, gas tips, etc., is constantly increasing, and at the present time the total production in the United States is not equal to the domestic demand. This scarcity has caused an increase in the price of the better quality of talc and has also caused a considerable quantity of Bavarian soapstone or steatite to be imported. Thus, any new property is worthy of investigation, as many of the larger producers and manufacturers of talc are on the lookout for deposits of talc suitable for their purposes.

PRODUCTION.

During 1905 the total production of talc and soapstone, with the exception of that mined in the mountain counties and cut into slabs for chimneys, etc., amounted to 4,035 tons valued at $74,690. This is an increase of 234 tons in quantity and of $9,032 in value as compared with 3,801 tons valued at $65,308, the production of 1904. The counties making this production were Swain, Cherokee, and Moore, given in the order of the importance of their productions. There were a total of five producers, the same as for the previous year. Besides the above, there was some soapstone quarried, principally in Ashe County, used for chimneys, fire-places, etc.

Very little of the talc produced is sold in the crude state, and, therefore, the value given for the talc production represents the manufactured products, and the production is classified as it is marketed, as ground, manufactured, rough, and for chimney purposes. In the table below is given the condition in which the 1905 production is marketed, together with that of the years 1903 and 1904:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1903, 1904, AND 1905.

CONDITION IN WHICH MARKETED.	1903.		1904.		1905.	
	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.	QUANTITY, SHORT TONS.	VALUE.
Ground talc for powders, etc.	3,762	$ 37,606	3,163	$ 32,217	3,529	$ 39,007
Talc cut into pencils, gas tips, etc.	265	27,615	208	28,673	205	32,568
Talc sold crude	1,304	11,763	430	4,417	301	3,115
Soapstone cut into slabs for chimneys, etc.	----------	----------	----------	175	----------	250
Total	5,331	76,984	3,801	65,483	4,035	74,940

The next table shows the quantity and value of talc and soapstone produced in North Carolina from 1898 to 1905 inclusive:

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1905. INCLUSIVE.

YEAR.	QUANTITY.	VALUE.	YEAR.	QUANTITY.	VALUE.
	Short Tons.			*Short Tons.*	
1898	1,695	$ 27,320	1902	5,239	$ 88,962
1899	1,817	31,880	1903	5,331	76,984
1900	4,522	75,308	1904	3,801	65,483
1901	5,819	77,974	1905	4,035	74,940

PRECIOUS STONES.

The precious stones or gem minerals of North Carolina have been described in some detail in previous reports[*] and there is now in press a bulletin on the Precious Stones of North Carolina by Dr. George F. Kunz, of Tiffany & Co., New York City.

PRODUCTION.

The total value of the production of precious stones of all kinds in North Carolina during 1905 was $3,350, which is a decrease of $6,250 as compared with $10,600, the value of the 1904 production. This large decrease is due largely to the fact that the beryl mines at Spruce Pine were only operated a very small portion of the year.

There is given in the following table the production of precious stones in North Carolina since 1900.

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[*] Economic Papers 6 and 9; Vol. I, N. C. Geological Survey.

PRODUCTION OF PRECIOUS STONES IN NORTH CAROLINA SINCE 1900.

YEAR.	VALUE.
1900	$12,020
1901	24,245
1902	5,300
1903	1,525
1904	10,600
1905	3,350

MINERAL WATERS.

The production and sale of mineral waters in North Carolina, while it has not yet reached a very large industry, has possibilities of becoming an industry of considerable value to the State. Most of the water that is bottled and sold is used for medicinal purposes, and there is very little that is marketed which could be called a purely table water. Spring water is being used more and more for table use, and North Carolina has springs of large flow whose water is pure, and if once introduced on the market would undoubtedly find wide favor as table water. During 1905 there were 10 springs that reported sales as follows:

Alkalithia Spring, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Jackson Spring, Jackson, Moore County.
Mida Spring, near Charlotte, Mecklenburg County.
Panacea Spring, near Littleton, Halifax County.
Red Spring, Red Springs, Robeson County.
Seven Springs, near Goldsboro, Wayne County.
Thompson Bromine-Arsenic Spring, Crumpler, Ashe County.
Vade Mecum Spring, Stokes County.

Many of these springs have hotels run in conjunction with them, having a total accommodation for about 1,000 people. Besides these springs that have made sales of water, there are a large number of springs located throughout North Carolina that are used in connection with resorts, such as the Haywood White Sulphur Springs, Waynesville, Haywood County; the Blackwood Sulphur Springs near Alexander, Buncombe County; the Hot Springs at Hot Springs, Madison County; the springs at Sapphire, Jackson County, etc.

PRODUCTION.

The total amount of mineral water bottled and sold in North Carolina during 1905 amounted to 201,000 gallons valued at $38,755. As compared with 145,800 gallons valued at $21,902 sold in 1904, this is an increase of 55,200 gallons in quantity and of $16,853 in value. In the following table there is given the production of mineral waters in North Carolina since 1901:

PRODUCTION OF MINERAL WATERS IN NORTH CAROLINA SINCE 1901.

YEAR.	AMOUNT, GALLONS.	VALUE.
1901	375,700	$42,167
1902	104,400	18,795
1903	83,100	13,085
1904	145,800	21,902
1905	201,000	38,755

GRAPHITE.

PRODUCTION.

The occurrences and uses of graphite have been described in detail in previous reports on the Mining Industry.* The production of this mineral has never amounted to a great deal in this State, and for the most part has been confined to one county. During the past year the production only amounted to 100 tons valued at $475, and was all obtained from Wake County. As compared with the production of the previous year, it is the same in quantity, but a decrease of $50 in value. In the following table there is given the production of graphite from 1901 to 1905 inclusive:

PRODUCTION OF GRAPHITE IN NORTH CAROLINA FROM 1901 TO 1905.

YEAR.	QUANTITY.	VALUE.
	Tons.	
1901	95	$ 559
1902	830	4,300
1903	50	248
1904	100	525
1905	100	475

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* Economic Papers 6, p. 68; No. 8, p. 48; No. 9, p. 62.

COAL.

The Chatham and Moore County coal areas are the only producers of coal in North Carolina. These deposits have been thoroughly exploited and it has been shown that the field is not very extensive or capable of being developed into a very large productive region. The seams of coal are faulted in many places, which, together with their narrow width, makes mining expensive. The output of the past few years has been very irregular, and practically all of the production has been made from the Cumnock mines.

PRODUCTION.

The first record of the production of coal in North Carolina is in the report of the United States Census for 1840, which states a production of 3 tons was obtained. From that time until coal was mined during the Civil War for use by the Confederate Government, there is no record of any coal being produced. From 1862 to 1867 the production was from 20,000 to 30,000 tons a year. It then began to fall off until 1873 the production was reported as 10,000 tons. From that year until 1880 there was no coal produced. For the next ten years the production amounted to only 222 to 500 tons per year. In 1889 the Cumnock or Old Egypt mines were reopened and have been producing ever since, although the production has been very erratic. The year of greatest production was 1899, when the quantity of coal produced was 26,896 tons.

During 1905 the production only amounted to 1,557 tons valued at $2,336, averaging $1.50 per ton. As compared with the production of 7,000 tons valued at $8,820 in 1904, this is a decrease of 5,443 tons in quantity and of $6,484 in value. Over two-thirds of this coal was sold to the local trade or used by employees. In the following table is shown the distribution of the coal product of North Carolina for the years 1901 to 1905.*

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* U. S. Geological Survey ; mineral resources separate on Coal, 1906.

DISTRIBUTION OF THE COAL PRODUCT OF NORTH CAROLINA, 1901-1905.

YEAR.	LOADED AT MINES FOR SHIPMENT.	SOLD TO LOCAL TRADE AND USED BY EMPLOYEES.	USED AT MINES FOR STEAM AND HEAT.	TOTAL QUANTITY.	TOTAL VALUE.	AVERAGE PRICE PER TON.	AVERAGE NUMBER OF DAYS ACTIVE.	AVERAGE NUMBER OF EMPLOYEES.
	Short Tons.	*Short Tons.*	*Short Tons.*	*Short Tons.*				
1901	10,000	----------	2,000	12,000	$ 15,000	$ 1.25	300	25
1902	20,400	100	2,500	23,000	34,500	1.50	285	40
1903	14,429	87	2,793	17,309	25,300	1.47	264	49
1904	4,600	300	2,100	7,000	10,500	1.50	240	25
1905	461	1,096	----------	1,557	2,336	1.50	60	15

The next table shows the production of coal in North Carolina since 1890, when the Cumnock mine was reopened.

COAL PRODUCTION IN NORTH CAROLINA FROM 1890 TO 1905.

YEAR.	QUANTITY.	YEAR.	QUANTITY.
1890	10,262	1898	11,495
1891	20,355	1899	26,896
1892	6,679	1900	17,734
1893	17,000	1901	12,000
1894	16,900	1902	23,000
1895	24,900	1903	17,309
1896	7,813	1904	7,000
1897	21,280	1905	1,557

PEAT.

The peat deposits of North Carolina are beginning to attract considerable attention, and during the past year many inquiries have been received regarding them. This is due partly to the many uses for which peat is adapted, the more important one being as a fuel, usually in the form of briquettes. It is found in swamps, marshes and bogs, where the drainage is hindered sufficiently to permit of vegetable growth. This accumulates and slowly decays under water, becoming constantly deeper. As examined, a peat deposit will usually show on top a layer of living vegetable matter; underneath this a mixture of partly decayed plants still showing well-defined fiber; and below this the spongy to black peat in which there may be a total absence of any fiber.

Swamps and marshes in which peat occurs may be either fresh-water swamps or marine swamps and marshes, and both these types are abundant in what is known as the "swamp lands" of eastern North Carolina, in many of which there are vast deposits of peat of varying quality and purity. There are also bogs and swamps in the Piedmont plateau and mountain regions of the State that may contain deposits of peat that are worthy of investigation.

In appearance, peat is often fibrous, although in many samples but few fibers can be distinguished. It is brownish to black in color, the latter representing the more thoroughly decomposed variety, which is more or less spongy and waxy and contains few or no fibers, while the brownish color is of the less decomposed peats, which are loose in texture and decidedly fibrous. When the peat is first taken out of these swamps it contains a very large percentage of water, the greater portion of which is readily lost by evaporation, but it requires a rather high temperature to eliminate all the water. Besides the decayed vegetable matter, peat contains more or less mineral matter which constitutes the ash. This often consists largely of clay, iron oxide, and calcium carbonate, and varies in peat, which will make a good fuel from 3 to 10 per cent.

The uses of peat are quite varied, the chief one being as a fuel. For this purpose it may be used directly after being dried, or after being manufactured into briquettes, the latter giving better satisfaction and greater heating efficiency. It can also be used in the manufacture of coke with by-products, such as gas, ammonia, tar, etc. It could also be used in the production of gas. For these uses, especially as a fuel in the form of briquettes, the deposits of eastern North Carolina are worthy of most serious consideration and thorough investigation.

The fibrous and spongy nature of the peat makes it of value for use as an absorbent in the manufacture of paper and for litter.

For agricultural purposes peat can be used to advantage, for its nitrogen content, and for this purpose the deposits of eastern North Carolina offer a promising field for investigation. It can also be used in packing as a non-conductor of heat and sound, and as a preservative for packing perishable articles, such as fish and fruits, for transportation.

During the coming year it is planned to thoroughly investigate the peat deposits of the State and to prepare for publication a report upon their occurrence, extent, chemical composition, value, etc.

The State Geologist would appreciate it if any one owning land containing peat will notify him of the extent of the bog or swamp and also send sample of the peat.

STONE.

INTRODUCTION.

There has recently been published by the North Carolina Geological and Economic Survey a report on the Building and Ornamental Stones of the State, which was prepared by Prof. Thomas L. Watson and Mr. Francis B. Laney, with the collaboration of Dr. George P. Merrill. This report represents nearly three years of field and laboratory work, and shows that North Carolina is well supplied with a great variety of building stone materials, particularly those of a granitic type. With perhaps the possible exception of Georgia, it is better supplied both as regards quality and variety than any of the other Appalachian States south of New England. When this fact is taken in connection with the mildness of the climate, which permits of a long season of outdoor labor, and with the cheapness of labor itself, it will undoubtedly result in the development of a very extensive industry.

The granitic rocks have been especially studied by Mr. Watson, who worked almost exclusively on the granites and gneisses, with incidental reference to the associated eruptives, the diorites, diabases and gabbros. In connection with the field work on these granitic rocks, he was ably assisted by Mr. Laney, who, however, devoted the larger part of his time to the marbles, limestones, sandstones, serpentines and road materials.

Dr. Merrill's guiding hand is plainly seen in the character of the work and its form of presentation. There were but few tests made to ascertain resistance to crushing, shearing, elasticity, or absorption, chiefly because the report does not pretend to be either exhaustive or final, but has been published to call attention to the deposits of stone, especially those of known economic importance, and to indicate how these can be opened and operated profitably. No chemical analyses were attempted, nor were they for the most part considered essential

North Carolina
State Library.

for the present work, as Dr. Merrill still adheres to his opinion that more can be learned from an examination in the field than through all known laboratory tests taken together. There are a number of chemical analyses given throughout the report, which have been taken, however, from previous reports of the Survey.

The volume is divided into nine chapters, with a short appendix on Stones for Road Building. In Chapter I, which is entitled Preliminary Generalities, the essential qualities of building stones are thoroughly discussed, attention being called to the influence that color has on the market value of a stone; the ease or difficulty with which a stone can be worked, and the location of the deposit with respect to transportation facilities. The surface features of the State are considered, and it is shown that the geological formations which are capable of yielding desirable stone for structural purposes or ornamentation traverse the State in northeast and southwest directions. Beginning at the western margin of the coastal plain, there is found extending northeast from Raleigh a broad belt of gneissic rocks, succeeded on the west by one of brown sandstone, and this in order by belts of schist, granites and gneisses to the State line, the last-mentioned belt carrying in Cherokee, Graham, and Swain counties a narrow belt of marble. Within these areas there are numerous minor exceptions to the regular order mentioned above. The geographic position of the State is considered with reference to other than local markets, and it is clearly shown that North Carolina is near the center of an area containing hundreds of large and prosperous cities and towns which will afford a market for a much larger amount of building stones than it is now supplying, which should result in the development of the quarry industry on a much larger scale and without any danger whatever of ruinous competition.

Chapters II, IV, and VI take up in detail the building and decorative stones roughly classified as follows: (1) The crystalline siliceous rocks, including the granites, gneisses and diabases, or trap-rocks; (2) the calcareous rocks, including all limestones and dolomites, both the crystalline and compact common varieties; and (3) the fragmental or clastic rocks, including the sandstone and clay slates.

The granites and other crystalline rocks result either as erupted molten matter from the earth's interior or from the metamorphism of siliceous sediments. Those of the second group originate mainly as deposits of calcareous mud from the breaking up of shells, corals, and the remains of other marine animals on an old sea bottom. Those of the third group result from the breaking up of older rocks, and the accumulation on the bottom of lakes and seas of the resultant sand, clay, or mud in beds of varying thickness, to be subsequently hardened into stone.

"The essential difference between a marble and a compact limestone, like those of Ohio or Kansas, is that the first has undergone, through the combined action of heat and pressure, just the right degree of change, or metamorphism as it is technically called, to develop in it crystallization and color; the essential difference between a brick or fire-clay and a cleavable slate suitable for roofing is, as explained elsewhere, that the first named still retains its plastic condition as it was laid down in the form of fine silt on a sea bottom, while the slate has by geological agencies, by actual movements of the earth's crust, been so squeezed and compressed as to lose all resemblance to its former self, and become the cleavable article of commerce we now find it.

"These processes of change, as noted above, are dependent very largely upon the actual movements, warpings and foldings, as one might say, of the earth's crust and the heat and chemical action which is thereby generated, and since these movements take place only with extreme slowness, whole geologic ages being occupied in their inception and completion, it follows as a matter of course that these metamorphic rocks, these gneisses, marbles and roofing slates, are found only among the older rocks and only in those portions of the country where this crust has been warped, compressed, and folded as in the process of mountain making."

Thus, one will find these rocks in their best development in those regions bordering along more or less extensive mountain ranges.

GRANITE AND OTHER CRYSTALLINE ROCKS.

The area of the State containing rocks of the first class is very extensive, and includes the three larger physiographic provinces of the State, namely, the Coastal Plain, the Piedmont Plateau, and the Appalachian Mountain; but the greater part of the granites and other crystalline rocks of economic importance are included in the Piedmont Plateau region. Along the inner margin of the coastal plain region there are a number of small workable areas of granite of excellent quality; but in the mountain region the large granitic areas are usually schistose in structure and are not very desirable for the higher grades of work in which granites are used. These crystalline rocks are discussed in groups:

I. The Coastal Plain Region. This area includes Wilson, Edgecombe, Nash, Anson, and Richmond counties. In this region the areas capable of producing workable granite either lie close to or are crossed by the principal lines of railroad in the eastern part of North Carolina, rendering them easily accessible and providing ample facilities for transportation of the stone. The outcrops are usually large and are so located as to offer advantageous quarry sites. They are all biotite granites, showing a considerable range of variation in color and texture, from light gray to pink, with occasionally a mixed yellowish and pink appearance. No systematic quarrying has as yet been undertaken, and all that has been quarried has been used locally.

II. The Piedmont Plateau Region. 1. The Northeastern Carolina Granite Belt, including Wake, Franklin, Vance, Granville, and Warren counties. In this belt extensive workable areas of different grades of granite are found suited for all classes of work in which granite is used, except for the better grades of monumental work. Systematic quarrying, however, has been limited, principally to areas in and around Raleigh, Wake County, and at and near Greystone and Middleburgh, Vance County. These quarries have been operated quite extensively, furnishing stone to eastern Virginia and Carolina, principally in the form of blocks and curbing for street purposes; and for general building purposes. Throughout this belt the granites show but little variation in mineral composition, and, with one exception, they are biotite-granites. Minerals, such as free sulphides and iron oxides, which are a source of discoloration to stone on exposure, are practically absent from the granites of this belt.

2. The Carolina Metamorphic Slate and Volcanic Belt, including Orange, Durham, and Chatham counties: The country rocks of this belt comprise argillaceous, sericitic and chloritic metamorphosed slates and crystalline schists; sedimentary pre-Juratrias slates and ancient volcanic rhyolites, quartz-porphyries, and pyro-clastic breccias that are often sheared and altered andesites. Rocks of granitic composition have as yet only been noted in Orange County, and they

are of doubtful commercial value except for railroad ballast and road purposes.

3. The Carolina Igneous Belt (The Main Granite Belt), including Mecklenburg, Gaston, Cabarrus, Iredell, Rowan, Davidson, Davie, Forsyth, Guilford, and Alamance counties. In this belt granite is one of the principal and most wide-spread rocks, and in each of the ten counties included in the belt extensive areas of granite are exposed. Outcrops of firm and hard moderately fresh granites are not uncommon, and, as a rule, the exposures are large enough to admit of the opening of large quarries without much stripping. The stone is usually well suited to the many purposes for which granite is used, and the belt is traversed in nearly all directions by lines of railroads which offer ample facilities for transportation. Notwithstanding these conditions, only a limited amount of quarrying has been done in these counties, with the exception of Rowan, where a systematic quarrying has been developed in a large scale on the Dunns Mountain granite ridge.

There are two distinct phases of the granite developed, an even-granular or normal and a porphyritic granite, both of which have wide distribution within the limits of the belt, and, with one exception, represent different phases of the same rock mass, the porphyritic texture grading into the even-granular. With hardly an exception the granites are mica (biotite) bearing, and they vary in color from nearly white, through the lighter to the darker shades of gray. In several places over Dunns Mountain a beautiful shade of pink granite is quarried. This stone has attracted a great deal of attention, and is much admired as a decorative stone.

4. The Western Piedmont and Granite Belt, including Surry, Wilkes, Alleghany, Alexander, and Cleveland counties. In this belt the massive granites are less abundantly distributed than over other parts of the granitic areas. They are all biotite-bearing, usually of light color and of medium texture. No injurious minerals are, as a rule, observed, the rocks possessing marked strength and durability, and are very desirable granites for certain grades of work. Mount Airy, Surry County, one of the principal localities in this belt yielding rock of this type, constitutes the largest quarrying center in the State. The demand for this stone is rapidly increasing, and wherever used has given entire satisfaction both as regards color and durability.

III. The Appalachian Mountain Region, comprising McDowell, Buncombe, Henderson, Madison, Haywood, Jackson, Macon, Transylvania, Swain, Mitchell, Caldwell, Watauga, and Ashe counties.

No systematic quarrying has as yet been undertaken at any point in this mountain region, but numerous small openings have been made in exposures of the rock in many places, the stone being used entirely for local purposes. The larger amount of the rock quarried has been used for ballast and road purposes. Transportation is the serious difficulty confronting the quarrying of the mountain granite for building purposes, except for local use.

The report shows that North Carolina is well supplied with granite deposits that are easily accessible and are of a quality that will permit of their being used for all grades of work.

Some of the rocks included under the head of the crystalline rocks are of especial interest and are mentioned more in detail.

Orbicular Gabbro-Diorite.—The orbicular gabbro-diorite is found on the Hairston plantation, Davie County, 10 miles west of Lexington and one mile west of Oaks Ferry. It occurs in high boulders, occupying a low indistinct ridge, which culminates in a peak or knoll about 30 feet above the surrounding plain. This is the only point where the orbicular rock outcrops prominently, but it can be traced in a southwest direction by means of residual decay for a distance of one-half to three-quarters of a mile in length and of several hundred yards in width. The orbicular rock undoubtedly occurs in the form of a typical dike, penetrating the porphyritic granite, and is parallel to and probably of the same age as some large massive unaltered diabase dikes in the vicinity which are intersecting the same rock.

This rock presents two distinct and strongly contrasted phases, one the pronounced orbicular and the other a granitic. Around the knoll referred to, the rocks show the typical orbicular texture, with the well-rounded spheres varying in width from one-eighth to one inch and sometimes two inches in diameter. Some distance from the knoll the rock assumes a granitic texture, but is composed of the same minerals. Mineralogically, this rock is composed principally of a basic plagioclase feldspar, showing, as a rule, but slight polysynthetic twinning, uralitic hornblende, and diallage. Besides these, titanite, apatite, magnetite and zircon occur as accessory minerals, and quartz, muscovite, calcite and zoisite as secondary minerals.

In color the rock is dark, with a greenish tinge due to the dark green hornblende. It has a pronounced mottled appearance produced by the nearly black green nodules of hornblende in a groundmass of the intensely white plagioclase feldspar. The contrast is very pleasing, and it is brought out much more prominently in the cut and polished surface. The spheres usually exhibit a fibrous radiating structure from a common center outward. In some instances a small fragment of feldspar, quartz, or pyrite has been the nucleus about which the spheres of the hornblende have been formed. The concentric structure which is usually observed in orbicular rocks is not at all pronounced in the North Carolina rock; and where the spheres of orbicular granite and diorite heretofore described are composed usually of a number of minerals, the North Carolina rock is only composed of one, the dark-green hornblende.

As a decorative or ornamental stone, this unique stone should find very great favor. It works easily and well, as is shown by a polished column and sphere that are in the State Museum at Raleigh. That it wears well is demonstrated by the fact that some of this stone quarried prior to the Civil War and used for gate-posts and steps to the house on the Peter Hairston property do not show any signs of decay. This deposit is being developed by the Consolidated Granite Company of Winston-Salem, and already many inquiries have been received regarding it.

Quartz-Porphyry (Leopardite).—Intersecting the biotite-granite at Belmont Springs, 1½ to 1¾ miles east of Charlotte, Mecklenburg County, is a dike of quartz-porphyry about one-half mile long, whose width nowhere exceeds 25 feet and which has been most appropriately named leopardite. It is a dense, hard, tough and compact cryptocrystalline rock, which breaks with a conchoidal fracture. The fresh rock is nearly pure white, tinged in places a very faint greenish, and penetrated by long parallel streaks or pencils of a dead black color. If it is broken at right angles to these streaks the surface is dotted with rounded irregular black spots, varying from pin-heads up to half an inch in diameter. When the rock is broken or cut parallel with the direction of the pencils the surface is streaked with long irregular black lines, which are sometimes approximately parallel and at others assume a dendritic or fern-like appearance. These black streaks or pencils are not regularly distributed throughout the quartz-porphyry, but in some areas they are entirely absent, while in others they are crowded very closely together.

Mineralogically, the rock is composed essentially of feldspar, both potash and plagioclase varieties, with a smaller amount of quartz, which forms minute irregular interlocking grains. Considerable of it is interwoven with the feldspar in micrographic structure, forming more or less rounded disk-like areas. The black streaks or pencils are composed of oxides of manganese and iron and are supposed to represent the percolation of manganese and iron solutions through the rock.

The rock is susceptible of an excellent polish and could be used with splendid effect in inlaid work. On account, however, of its exceeding hardness and toughness and absence of any definite rift, it will be a rather expensive stone to quarry. This rock is also being developed by the Consolidated Granite Company of Winston-Salem.

Unakite.—In Madison County, about 5 miles southwest of Hot Springs, there is an irregular area of granite containing epidote as a characterizing mineral. The main mass of this rock is described as a dark pink and green epidote-biotite-granite of coarse texture and somewhat schistose structure varying from a typical schistose granite in which the quartz is present in the usual amount to a nearly quartzless rock of the same color and texture.

Penetrating this granite probably in the form of narrow veins is the unique and beautiful variety of granite known as unakite. This rock is composed of yellow-green epidote, dull pink or red feldspar and quartz. The unakite is not uniform in color and composition, but shows pronounced gradations into a highly feldspathic rock of pink color on the one hand and an epidote rock of a yellow-green color on the other. Usually in the veins the normal unakite, which is a coarse, massive rock of even texture, occupies the middle portion of the vein and graduates toward the enclosing gneiss either into the feldspathic or epidotic rock or both.

Under the microscope the unakite is shown to be composed of the usual granitic minerals, such as orthoclase, quartz, occasional biotite, zircon, apatite, rutile, magnetite and a few small grains of pyrite, with the secondary minerals epidote, chlorite, kaolin and a green mica.

One of the best exposures of the unakite in its relation to the other granitic rock is along Roaring Fork and a short distance above its entrance into Meadow Fork. The commercial value of the rock would be for decorative or ornamental purposes, but at the present time it has not been developed sufficiently to determine what quantity of this rock can be obtained commercially.

In Chapter III there is a short description of the dikes and veins penetrating the crystalline rocks previously described, which includes, beginning with the most acid, true quartz veins, pegmatite, aplite and granite dikes of normal composition and texture; and abundant dikes of basic igneous rocks, of which diabase and diorite are the most common types.

LIMESTONE AND MARBLE.

Chapter IV treats of the calcareous rocks, limestones and marbles, taking up in detail their varieties, structure, weathering qualities, uses, and geographical distribution. The marble localities are confined to Cherokee, Swain, McDowell, and Mitchell counties. The only ones that have been developed commercially are those in Cherokee County. The marble of Mitchell County is perhaps worthy of more detailed notice on account of its occurrence and quality.

White Marble from Mitchell County.—This marble was first exposed in a railroad cut on the north bank of North Toe River, near the mouth of Sink Hole Creek, about 3½ miles above Toe Cane Station. The marble is exposed in a bed about 60 feet thick interbedded with typical mica-schist, is exceptionally pure and of very uniform texture. As far as can be judged from the exposure of the blocks that are blasted out, it is remarkably free from joints. It has a beautiful pure white color and takes a good polish. It can be traced northeastward from the outcrop at the railroad for about a mile and is favorably located for quarrying, being on a mountain-side about 100 feet above the valley, thus affording natural drainage and space for disposal of waste material. Considering the location of this marble and its texture, purity and color, it offers a very favorable commercial quarry proposition. One peculiar feature of this marble deposit is the occurrence of a large pegmatitic vein in the midst of the marble.

The limestone areas are rather scarce throughout North Carolina and in no place are they of sufficient magnitude to be of any large commercial importance either for building purposes or for burning into lime. In a few localities a small amount of the stone is used for road purposes or burned into lime for local use. In Buncombe County, about 2 miles north of Fletcher, two kilns having a capacity of 700 bushels per day have been erected for burning a limestone that is of a peculiarly fine-grained structure, containing little or no impurities, the analyses giving 95.32 per cent calcium carbonate. These kilns are operated by the Blue Ridge Lime Company.

The Serpentines and Verdantique Marbles are described in Chapter V. They are at the present time of no commercial importance, and they have been described in detail in a previous report of the North Carolina Geological Survey on Corundum and the Peridotites of Western North Carolina.

The Sandstones and Quartzites, which are taken up in Chapter VI, are discussed more from a commercial than a scientific standpoint. Although in previous years there has been considerable quarrying of the sandstone from Moore County, in recent years the industry has come nearly to a standstill. This, however, has not been on account of the quality of the sandstone as much as transportation difficulties.

The dikes penetrating the sandstones are taken up in Chapter VII, which contains tables showing their distribution and their relation to the jointing of the sandstone.

Chapters VIII and IX relate to the quarrying, working and weathering of building stones. One interesting method of quarrying building stones that is especially mentioned is that used by the North Carolina Granite Corporation at its Mt. Airy quarries, which is described as follows:

> "In the center of the sheet or area to be lifted a drill-hole 2 to 3 inches in diameter is sunk 6 to 8 feet in depth, depending on the greatest thickness of stone required, and the operation is continued by the discharge of successive small amounts of powder similarly as described under the method of quarrying by using water* until the crevice extends a distance of 75 feet or more from the hole in all directions. A pipe is then cemented into the hole and connected by means of a globe valve to an air-pipe line from an air compressor. Compressed air at 70 to 80 pounds pressure is gradually admitted and the cleavage rapidly extended until it comes out upon the hillside in a thin edge. A sheet of several

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* After being drilled, the hole is fired by a succession of light blasts, using in the first charge about a handful of blasting powder. The operation is begun by discharging about a quarter of a pound of dynamite in the bottom of the hole. This small charge of dynamite pulverizes the stone slightly at the bottom of the hole and forms a small chamber. The tamping is then cleaned out by the hole, which is recharged in the same manner, this time, however, using about a handful of powder. The recharging of the hole is continued with small charges of powder until a small seam has been started at the bottom of the hole extending parallel with the surface. This is found out by using a small steel rod bent at the lower end and sharpened to a point and passing it up and down the hole until the crack is located. After the crack has once been started, the use of light charges of powder is continued, increasing the charges gradually as the seam is found to extend in all directions from the lift hole until the crevice extends a distance of 75 feet or more from the hole.

> acres in extent may be raised in this manner, affording a bed plane approximately horizontal, to which the quarrymen can work, thus securing stone of any required thickness. The first time compressed air was used a pressure of 80 pounds was admitted into the cavity which had previously been extended to a distance of 100 feet from the lift-hole. The power of the air, however, was too great for the easily-splitting stone and the cleavage turned abruptly to the surface. In the next hole, however, the compressed air was admitted very gradually and the stone could soon be heard cracking in all directions, and in about half an hour the cleavage came to the surface of the hillside as a thin edge some 225 feet from the lift-hole. To extend the cleavage by means of powder for a hundred feet would require from 6 to 12 days, and with water from 3 to 5 hours, while with the compressed air the larger area was split in half an hour."

Appended to the volume is a short description of stone found throughout the State that is suitable for road building, together with a table showing the results of tests made on certain stones suitable for use in road building.

Although this volume deals especially with the economic and commercial phases of the building stones of North Carolina, making it particularly interesting and valuable to contractors, builders and dealers in building stones; yet there is sufficient detailed scientific work included to make it of considerable interest and value to the student of North Carolina geology.

PRODUCTION OF BUILDING STONES.

In 1905 the total value of the production of all kinds of stone in North Carolina was $597,922. As compared with $312,576, the value of the 1904 production, this is an increase of $285,346.

There is given in the table below the value of the production of the various stones quarried in 1900 to 1905:

PRODUCTION OF BUILDING STONES IN NORTH CAROLINA, 1900-1905.

YEAR.	GRANITE.	SANDSTONE.	MARBLE AND LIMESTONE.	TOTAL VALUE.
	Value.	*Value.*	*Value.*	
1900	$ 257,962	$ 27,210	$ *	$ 285,172
1901	264,906	11,682	8,357	284,945
1902	338,749	4,825	23,153	366,727
1903	334,357	600	25,365	360,322
1904	292,439	250	19,887	312,576
1905	564,425	4,482	29,015	597,922

* Statistics not collected for 1900.

PRODUCTION OF GRANITE.

There was a most gratifying increase in the production of granite during 1905 as compared with that of any previous year. This is due to the more extensive advertising of North Carolina granite and its favorable reception in new markets. During 1905 the total value of all the granite produced was $564,425, which, compared with the value, $292,439, was an increase of $271,986. Although this increase is nearly double that of the previous year, it still does not begin to represent what the granite industry of the State should attain. Next year will undoubtedly see a still further increase in the value of the granite production. The number of operators quarrying the granite during 1905 was 23, an increase of 7 over the number of 1904, and these worked 27 different quarries in the following 12 counties, given in the order of the importance of their productions: Surry, Rowan, Polk, Warren, McDowell, Buncombe, Orange, Henderson, Vance, Davie, Gaston, and Cabarrus. Rockingham, which produced a considerable amount of granite in 1904, used entirely for railroad ballast, did not make a production in 1905. Three new counties, however, are added to the list of those producing granite, namely, Warren, Davie, and Cabarrus. The production from Cabarrus was entirely for railroad ballast and was represented by the same company that was working in Rockingham during 1904, producing ballast for the Southern Railway. The new operator in Warren County is the Wise Granite Company of Wise, who produced granite that was used for a great variety of purposes, including rough and dressed building and monumental stone, paving blocks and curbing and road macadam. Considering the character and extent of the granite deposits of Warren County, this will probably be but the beginning of a granite production in this county which will increase from year to year.

One-half of the granite produced in the State during 1905 was used for building and monumental purposes, the value being $312,362. This is greater than the value of the total production of granite in 1904, and is the best evidence of the great increase in the granite industry, and indicates that a better quality of granite is being quarried and more care and attention is given to methods of quarrying. It is the strongest evidence of the real value of the granite industry to the State and what can be accomplished by push and energy. This value is over 4 times the value of the granite used for the same purposes in 1904, and is approximately twice as great as the largest value previously reported for granite used for this purpose, which was the production of 1903, when the value was $167,639. There was a slight increase in the value of the granite used for road-making, railroad ballast, etc., the value of the 1905 production being $118,470 as compared with $93,296, the value of the 1904 production. There is given in the following table the value and uses of the granite quarried from 1902 to 1905 inclusive:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901-1905.

Uses.	1901.	1902.	1903.	1904.	1905.
Building and monumental purposes	$ 108,574	$ 167,639	$ 127,486	$ 75,632	$ 312,362
Paving blocks	10,662	6,986	30,780	15,807	48,234
Curbing and flagging	56,245	82,615	68,099	101,632	74,307
Crushed stone for road-making, railroad ballast, etc.	89,425	77,759	102,524	93,296	118,470
Other purposes	----------	3,750	5,468	6,072	11,052
Total value	264,906	338,749	334,357	292,439	564,425

There is given in the following table the value of the granite product from 1897 to 1905 inclusive, which shows most strikingly the growth of this industry in the State. In nine years it has increased nearly tenfold:

PRODUCTION OF GRANITE IN NORTH CAROLINA, 1897 TO 1905.

Year.	Value.
1897	$ 59,236
1898	79,969
1899	225,544
1900	257,962
1901	264,906
1902	338,749
1903	334,357
1904	292,439
1905	564,425

PRODUCTION OF SANDSTONE.

The sandstone industry has not yet assumed any large proportion and for the two years previous has been nearly at a standstill. The sandstone deposits are rather extensive, as described in the report referred to above, and some of them are capable of being developed into quarries that would furnish a good building stone. There was only one quarry worked in 1905, the Carrington-Gonella quarry, near Sanford, Moore County. A deposit that is rather favorably located for quarrying and gives indications of producing a sandstone suitable for building purposes is on the property of Mr. Benehan Cameron of Raleigh, which is located at Farintosh, Durham County. If a quarry were developed at this locality it would have good railroad transportation.

During 1905 the production of sandstone amounted in value to $4,482. The previous year it was only valued at $250 and in 1903 $600. One encouraging feature of the 1905 production is that nearly all of it was dressed stone for building purposes. In the table below is given the value of the production of sandstone for the years 1897 to 1905 inclusive, and will illustrate how small this industry is in the State:

PRODUCTION OF SANDSTONE IN NORTH CAROLINA, 1897 TO 1905.

Year.	Value.
1897	$11,500
1898	9,100
1899	10,300
1900	27,210
1901	11,682
1902	4,825
1903	600
1904	250
1905	4,482

PRODUCTION OF MARBLE AND OTHER FORMS OF LIMESTONE.

Notwithstanding the demand that there is in North Carolina for lime, there is still but a very small amount produced in this State, and nearly all is imported. One of the main reasons for this is the excessive railroad rates on lime shipped from North Carolina kilns. The Blue Ridge Lime Company, who were operating kilns near Fletcher during the past year, have doubled the capacity of their kilns and should very largely increase their production of lime for the coming year. During 1905 the total amount of lime produced amounted to 22,800 bushels valued at $7,660 and was obtained from

Henderson and Buncombe counties. The balance of the production of lime rock in the State for 1905 was used for road macadam and amounted to 17,084 tons valued at $21,355, and was all obtained from New Hanover County. There was no marble at all produced in the State during 1905. The total production of lime rock was valued at $29,015, and is the greatest value reported for any year since the records have been collected.

In the following table is given the value of the production of limestone and marble from 1901 to 1905 inclusive:

PRODUCTION OF MARBLE AND OTHER FORMS OF LIMESTONE, 1901-1905.

YEAR.	VALUE.
1901	$ 8,357
1902	23,153
1903	25,365
1904	19,887
1905	29,015

SLATE.

There was no production of slate in North Carolina during 1905.

SAND AND GRAVEL.

There is an enormous quantity of sand and gravel produced each year and utilized for various purposes. The value of a considerable proportion of this sand and gravel amounts to only the time and labor required to dig and haul the material to the point of consumption, and it is practically impossible to estimate or give any quantity or value for a great deal of these materials that are utilized each year. Thus, large quantities that are used in railway, highway, and sidewalk construction have not been estimated. While most of this has a value of from 5 to 15 cents per ton, it has been impossible thus far to obtain any adequate idea of the quantity of the product utilized each year. The general uses of sand outside of those already enumerated are for flux in copper smelting; for fire-proofing; molding sand, which varies considerable in value, as in making fine castings and heavy castings it is necessary to use a particular quality of sand, while for ordinary castings a more ordinary sand can be used; glass-sand used in the manufacture of glass, which must be a purer sand than that used for any other purpose; building sand used for mortar, plaster and concrete structure; fire-engine and furnace sands, which are particular qualities of sand adapted for these particular purposes; a grinding-sand, which is used for cutting and grinding stone, glass, etc.; sand used in the manufacture of brick, pottery, sanitary ware, etc.; and sand used in sand-blast machines. Gravel is used in large quantities as rough material for ballast on railways and highways and in concrete work. Of the above uses of sand and gravel, statistics have only been collected during the past year for that used in molding. As far as is known, there is no sand produced in North Carolina for use in the manufacture of glass; but for all the other purposes enumerated above there is more or less sand produced in North Carolina.

When it is considered that there are approximately 150,000,000 brick made and used in North Carolina each year besides those imported into the State, which run up well into the millions, one can obtain some idea of the amount of sand that has been used in making the mortar for laying this number of brick. Estimating this amount of sand at one ton per thousand brick and the number of brick used in North Carolina at 200,000,000, it would make 200,000 tons of sand. Besides this large amount of sand there is an enormous quantity used in the manufacture of plaster used in the large number of buildings that have been constructed during the past year.

The figures obtained for the production of molding sand were 859 tons valued at $547. This does not represent all of the sand used for this purpose, as a considerable amount has been used by foundrymen, which has been obtained close by their shops and no special record kept of the quantity or of its cost.

SAND-LIME BRICK.

The manufacture of sand-lime brick is becoming an industry of some importance in North Carolina, and it offers possibilities of a much greater growth. While as yet the production of these brick in the State is not very large, yet it has increased during the past three years and the brick command a considerably higher price than the clay-brick. As this industry is comparatively new in North Carolina and as it offers possibilities for profitable investment at a number of localities throughout the State, a short description of sand-lime brick, their manufacture, etc., may be of interest.

A sand-lime brick consists of sand particles that are cemented together by calcium silicate, or calcium magnesium silicate or calcium hydro-silicate. This cementing material is obtained by the action of steam under pressure upon either a high calcium lime or a magnesium lime which has been previously hydrated. The sand and lime in certain definite proportions are mixed together and then sufficient water added tô hydrate the lime, when they are molded and put in a furnace and subjected to steam under pressure. There is a definite chemical reaction that takes place, and the calcium silicate or calcium magnesium silicate or calcium hydro-silicate that is formed is a definite chemical compound and forms a strong binding material between the particles or grains of quartz.

As stated by Mr. S. P. Peppel:*

> "The sand-lime brick of to-day is the natural outcome of the improvements made in the old mortar brick, which has been known for years. This mortar brick was at first never more than a molded mixture of lime and sand mortar which was allowed to harden in the air. Later, carbon dioxide was supplied artificially in large quantities so as to hasten the process of hardening. The next improvement was the introduction of carbon dioxide under pressure. Following this use of carbon dioxide under pressure and in the presence of moisture, mild heat was applied. This last process is still used to some extent. But the most marked advance was the one which applied an entirely new principle to the hardening of sand and lime mixtures, and produced what is known to-day as sand-lime brick, an entirely different body from that of the mortar brick. This was the invention of Doctor Michaelis. Some twenty-five or thirty years ago he patented a process for the hardening of mixtures of lime and sand by steam under pressure, thereby introducing into the sand-lime brick an entirely different bond from that in the mortar brick, which in reality has no bond, but only a hardened or solidified filler.
>
> "Doctor Michaelis allowed this patent to lapse without commercial development, and in consequence the fundamental principle on which the manufacture of sand-lime brick is based is now public property, and all patents must be on details of manufacture or combinations of such details. The term "mortar brick" should be confined to the brick which is hardened by the solidification of the lime through the formation of carbonates, and should not be confounded with the sand-lime brick, which is a different product and has materially different properties."

There are a number of processes that have been introduced for the manufacture of sand-lime brick, some of which have been patented. They all, however, involve the same fundamental principle, the formation of a calcium silicate bond, and the value of each depends on the economy with which they can be operated.

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* U. S. Geological Survey Mineral Resources, 1903, p. 866.

The following description of the manufacture of sand-lime brick and materials used is drawn largely from the article referred to above. The raw materials used in the manufacture of these brick consist of a comparatively pure quartz sand or granular silicate and a comparatively pure calcium lime or magnesium lime, the former giving the better results. While most any sand could be adapted and would give a hard brick at the time of its manufacture, yet if the sand contains a good many impurities, the brick will yield more readily to weathering than one made with the pure sand. There are a number of localities in Cherokee, Swain, Transylvania, Henderson, Buncombe, Madison, Mitchell, McDowell, Catawba, Lincoln, Gaston, Craven, Beaufort, Onslow, Duplin, Pender, Brunswick and New Hanover counties that contain calcareous rocks, as the limestone, marbles, shell-rock, etc., that are in close proximity to sand-beds, and many of these offer favorable opportunities for the manufacture of sand-lime brick.

It is very essential in the manufacture of these brick that the raw material be properly prepared, for if the lime is not evenly distributed throughout the mixture the strength of the brick will be lessened, and if the material is not thoroughly mixed and the lime thoroughly slaked masses of lime may remain sufficient to cause rupture by expansion during the process of hardening, due to the complete hydration of the unslaked lime by the steam.

It is also necessary to select the raw materials, sand and lime, carefully, if the best results are to be obtained. Sand varies widely in its texture and also in the amount of other minerals constituting impurities that are associated with it. Sand may be very coarse or very fine and all degrees of coarseness between the two. It may contain as impurities clay, mica and feldspar (three silicates) and limonite, a hydrous ferric oxide. Perhaps the most common and widespread impurity of sand is clay. A sand containing up to 6 or 8 per cent of clay can be used without any serious disadvantage. Any larger percentage of clay than this will necessitate the use of a larger percentage of lime to obtain the same quality of brick, and with too high a percentage of clay, the resultant brick will not be as strong and will be apt to disintegrate when acted upon by age and water. Feldspar up to 10 per cent does not seem to have any seriously injurious effect upon the brick. The limonite, iron oxide, does not apparently affect the strength of the brick, but will determine its color, this oxide reacting to give the brick some shade of red color.

Experiments seem to show that for the rapid and economical production of sand-lime brick a certain proportion of very fine sand should be used, and that the stronger brick are obtained by using a mixture of coarse and fine sand in the proportion of 3 parts of coarse to 2 parts of fine to 2 parts of coarse and 1 part of fine sand. The finer the material that is used the more difficult it will be to mix the materials together so as to get a coating or film over each particle of sand; but, on the other hand, the resultant brick will be more compact and have a neater appearance. A sharp sand will give better results than sand with round corners, although sand-lime brick made of this latter sand will have sufficient strength to answer all requirements, especially if some fine material is introduced prior to manufacture. A coarse sand would represent one from 20 to 80 mesh and fine sand from 150 up.

Most any lime can be used in the manufacture of sand-lime brick, but experiments seem to show that a calcium lime will give a stronger brick than a magnesium lime. It is essential for the best results that the lime should not be badly air-slaked, and in determining what lime to use, consideration must be given to the fact that calcium lime air-slakes much more readily and rapidly than magnesium lime. There is usually used from 5 to 10 per cent of lime, according to the quality and type of the lime as well as its condition and proportion. The calcium lime will slake more rapidly in preparing it for manufacture of the brick than the magnesium lime, and thus requires much less time and care to insure a thoroughly slaked product, which is essential to the best success in the manufacture of sand-lime brick. There are two distinct classes of processes for slaking the lime, one in which lime is slaked to putty with a slight excess of water and then allowed to stand for some time. By this method the best possible product is obtained, and this may be used either in the condition of a putty or after being dried and ground to a flocculent powder. The other method is cheaper and easier of operation and consists of slaking the lime to a dry powder, either by the addition of sufficient water during the agitation of the lime to hydrate as completely as possible and still to leave a dry powder, or by slaking with the aid of steam in an enclosed vessel. Most of the lime is slaked prior to being mixed with the sand, and probably the simplest and surest way of manufacture is by taking the dry sand and a thoroughly slaked dry calcium hydrate (slaked lime) and mixing them thoroughly in the desired proportions before any water is added.

The mixing process should be carried out very carefully and thoroughly in order that the lime may be distributed throughout the entire mass, and in this process the presence of the fine sand seems to assist it materially. There are a great many mixing machines in use and all those of the intermittent type yield a thorough mixture, provided it is retained sufficiently long in the machine. The amount of water introduced should only be just enough to yield a mass which will just cohere together when squeezed so as to be capable of retaining its shape after passing through the press so as to be transferred to the steam or hardening cylinders.

The machinery needed for a sand-lime plant consists of—

Power and transmission;
Lime-preparing machinery;
Mixing apparatus;
Presses;
Hardening cylinders;
Conveyors;
Tracks and trucks.

The power and transmission machinery does not differ materially from that used in other industries.

The lime-preparing machinery has already been incidentally mentioned. When the quicklime processes are used the only preparing machinery necessary is such as will reduce the lump-lime to fine powder. This usually consists of a small crusher and a grinder or pulverizer. This machinery should be so constructed or so located as to confine the dust either to the machine itself or to a small compartment. For plants with sufficient capacity the best arrangement is to have a pulverizer with an air separator.

In plants which hydrate their lime prior to mixing with the sand, the machinery used is some sort of a crusher or breaker, which breaks the lime down to small lumps, varying in size from that of a pea to about ¾-inch in diameter. This breaker is not always used.

Dry hydrate slaking may be divided into two processes, open slaking and inclosed slaking. Open slaking is accomplished in several ways. In the most simple form of open slaking, floor space or bins, usually constructed of concrete, are used, and sufficient water is added to the lump-lime, so that after it has stood a few days and dried off, it is for the most part slaked. The resultant product is then screened, and the fine material used, and the remainder thrown back for re-slaking. There is a patent process of the same type in which the lime is wet, and then covered with a coating of previously hydrated lime which serves as a protection from the action of the air and retains a good deal of the heat and steam generated. Open slaking machinery properly consists of mixing machinery, which is not covered. There are a number of machines now used for this purpose, some of them on the pug-mill order, and others on the wet or dry plan. Some are patented and some are not. The patents mainly apply to details of manipulation and not to the mixing machines themselves. One of the patents in this class slakes finely-ground quicklime by constant agitation with water, another slakes lime or ground lime to a putty, and then dries this product by the addition of more quicklime.

"The inclosed slaking machines are of three kinds. One kind agitates the lime in an inclosed vessel with water alone; another type not only uses water, but introduces some live or exhaust steam as well; the third kind slakes in an inclosed cylinder, and has been patented; but the patent is at present in the courts, and their decision will decide whether it is public property or not."

The mixing machinery now in use fall pretty closely within the following four types: Wet plan, pug mill, ball or tube mill and an inclosed cylinder with curved paddles or S-shaped mixing arms.

There is at the present time no press that probably gives entire satisfaction and fulfills the following requisites for a good press: Of being able to deliver regularly a pressure of from 200 to 250 tons per brick and yet not break down if by accident the pressure becomes somewhat greater; of filling the mold with great accuracy and uniformity; of having its working parts so arranged that they will be very free from contact with loose sand, which would otherwise cut them out at an alarming rate; of having the linings of its dies and molds made of the hardest material possible. There are two distinct types of presses in use, one known as the ordinary American dry pressed brick machine and other known as the German type of machine, which has a rotary table.

The hardening cylinders consist of enormous steam-tight iron or steel receptacles so constructed that cars loaded with brick can be readily introduced into them and resembling in appearance enormous boilers or steel tubes with one entire head removable. These vary in size from 5½ to 7 feet in diameter and from 35 to 67 feet in length.

Conveyors, tracks, trucks, etc., vary with different plants and mode of construction of same.

The estimated cost of a well-equipped sand-lime brick plant having a capacity of from 16,000 to 20,000 brick in 10 to 12 hours, independent of the site, is worth from $20,000 to $25,000, varying with the cost of machinery and labor and locality at which it is erected. The cost of production of the brick independent of depreciation of machinery and interest on investment varies from $3 to $5 per thousand, while the selling price ranges in different localities from $8 to $15 per thousand.

PRODUCTION.

During 1905 the production of sand-lime common brick in North Carolina amounted to 3,185,000 brick valued at $20,953, and 660,000 front brick valued at $8,150, making a total of 3,845,000 brick valued at $29,103. The production of 1904 was 1,800,000 valued at $17,500. The 1905 production was made by three producers, one each in Buncombe, Scotland, and New Hanover counties.

CLAY.

Although the production of clay products in North Carolina has constantly increased during the past few years, yet the industry does not begin to be as great as the quantity and quality of the various clays in the State would warrant. The better qualities of clays are still shipped outside the State, and there have been no new companies organized to manufacture terra-cotta, pottery or other finer grades of clay products. As has been indicated before, it is not a lack of demand for this product in the State, for large quantities of them are imported each year. The total value of all clay products manufactured in 1905 is largely in excess of that of 1904, amounting to $1,038,430. Including the value of kaolin the total value of the clay industry in the State in 1905 was $1,124,052.

There is a large field for investment in clay products in North Carolina, especially in the manufacture of pressed, fancy and vitrified brick; in the manufacture of earthenware, stoneware and decorative ware; and in the manufacture of porcelain, electrical insulators, etc.

KAOLIN.

Production.

During 1905 the production of kaolin in North Carolina amounted to 10,988 tons valued at $85,622, as compared with 9,110 tons valued at $76,670 in 1904, being an increase of 1,878 tons in quantity and of $8,952 in value. The average value per ton of the 1905 production was $7.79 per ton, which is a decrease of 62 cents as compared with the average value of $8.41 per ton of the 1904 production. This production was obtained from Jackson, Swain, and Richmond counties, given in the order of the importance of their productions.

POTTERY CLAY.

Production.

The decline in the pottery industry that was noted in the report for last year continued during 1905, the value of the production being only $13,319 as compared with $13,900, the value of the 1904 production, a decrease of $581. This small production was divided amongst 24 manufacturers in the following 9 counties, given in the order of the importance of their productions: Buncombe, Union, Wilkes, Lincoln, Catawba, Randolph, Chatham, Johnston, and Moore. Montgomery County, which reported a production in 1904, made no production in 1905, but Moore County was added to the list of those producing pottery. None of the 24 manufacturers produced any great amount of pottery, the largest one only producing pottery to the value of $2,000. Of the 1905 production, $387 was the value of red earthenware and $12,932 the value of stoneware.

Notwithstanding the constant demand for red earthenware and stoneware and the large amount of this material that is imported, there has been no special interest aroused in this industry in the State. By utilizing better material for glazing the ware and exercising more care in the manufacture of the pottery a better and more uniform product could be put on the market, but the two essentials for the development of this industry are capital and experienced men.

There was a small amount of pottery clay sold crude in 1905, amounting to 50 tons, valued at $25, and was obtained from Catawba County. The values of the different grades of pottery produced during 1904 and 1905 are given by counties in the following table:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES IN 1904 AND 1905.

COUNTY.	1904.			1905.		
	EARTHEN-WARE.	STONE-WARE.	TOTAL.	EARTHEN-WARE.	STONE-WARE.	TOTAL.
Buncombe	$ 31	$ 1,300	$ 1,331	$ 125	$ 2,725	$ 2,850
Catawba		4,450	4,450		1,930	1,930
Chatham		600	600		500	500
Johnston	50	350	400	100	150	250
Lincoln	15	3,970	3,985	20	2,059	2,079
Montgomery	50	300	350			
Moore					100	100
Randolph	150	1,040	1,190		790	790
Union	100	300	400	100	2,400	2,500
Wilkes	42	1,152	1,194	42	2,278	2,320
Total	438	13,462	13,900	387	12,932	13,319

FIRE-CLAY AND PIPE-CLAY.

Production.

Under the head of the production of fire-clay and pipe-clay products are included fire-brick, sewer-pipe, drain tile, fancy tile, flue linings, terra-cotta, etc., and fire-clay and pipe-clay sold crude. In 1905 the total value of all these products reported was $111,272. This is a decrease of $2,928 as compared with $114,200, the value of the production of 1904. This branch of the clay industry in North Carolina has up to the past year increased rapidly since 1900, but there is plenty of room for a much greater advance to be made.

Of the 1905 production, $8,333 was the value of 681,000 fire-brick, which were manufactured in Buncombe and Cabarrus counties. This is an increase of 518,000 brick in quantity and of $5,633 in value as compared with 163,000 brick valued at $2,700, the production of 1904. There was also a small amount of crude fire-clay sold in 1905 amounting to 57 tons valued at $494. The production of terra-cotta, sewer-pipe, tiling, drain tiles, etc., during 1905 was valued at $102,445, and was obtained from Guilford, Wake, Beaufort, Randolph, and Forsyth counties, given in the order of the importance of their productions. This is a decrease of $8,355 in value as compared with $110,800, the value of the 1904 production. There is given in the following table the production of fire-clay and pipe-clay products for the past 5 years and shows the decided increase in the value of this industry:

PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN NORTH CAROLINA, 1901-1905.

YEAR.	FIRE-BRICK.		SEWER-PIPE, TILE, ETC.	CRUDE CLAY.	
	QUANTITY.	VALUE.		TONS.	VALUE.
1901	55,000	$ 550	$ 55,745		$ 100
1902		1,203	72,618		215
1903	407,500	5,250	100,989	231	875
1904	163,000	2,700	110,800	80	700
1905	681,000	8,333	102,445	57	494

BRICK-CLAY.

Production.

In nearly every county in North Carolina there are clay deposits suitable for the manufacture of common brick, these consisting of both residual and sedimentary clays. In some the deposits are very extensive from which excellent brick can be made. In many instances the brick-yards can be favorably located near railroad transportation, and fuel for burning the brick can usually be obtained at a very low price. Notwithstanding the advantages for brick manufacture in the State, the brick industry has not been as valuable as it should have been, and this is largely due to the lack of capital for installing machinery and also for lack of men experienced in brick manufacture. With the exception of fire-brick, the total number of brick manufactured in North Carolina during 1905 amounted to 154,885,000 valued at $913,814. This is an increase of 9,956,150 brick in quantity and of $97,095 in value as compared with 145,928,850 brick valued at $816,719, the production of 1904. The average value per thousand of the 1905 production was $5.89 as compared with $5.54, the average value per thousand of the 1904 production, this being an increase of 35 cents per thousand. There were 59 counties from which this production was obtained, which is two more than in 1904, which in turn was five less than in 1903. These counties—Carteret, Gates, Macon, Montgomery, and Transylvania—which reported a production of brick during 1904, reported none during 1905, while Anson, Franklin, Madison, Pender, Perquimans, Stokes, and Yadkin, which made no production during 1904, became producers in 1905. Of the 1905 production there were 153,610,000 common

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brick valued at $896,289, which is an increase of 9,621,150 brick in quantity and of $100,795 in value as compared with 143,988,850 common brick valued at $795,494, the production of 1904. The number of pressed and fancy brick manufactured in 1905 was 875,000 valued at $13,925; and of vitrified brick 400,000 valued at $3,600, as compared with a production of 1,510,000 pressed brick valued at $17,375 and 430,000 vitrified brick valued at $3,850 in 1904. In the table below is given the quantity and value of common, pressed, vitrified, and fire brick produced during the past four years:

PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND FIRE BRICK IN 1902, 1903, 1904, AND 1905.

CHARACTER.	1902.		1903.		1904.		1905.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	131,618,700	$694,827	136,822,900	$731,802	143,988,850	$795,494	153,610,000	$896,289
Pressed brick	1,833,000	10,625	766,000	8,230	1,510,000	17,375	875,000	13,925
Vitrified brick	600,000	6,000	500,000	5,000	430,000	3,850	400,000	3,600
Fire-brick	120,000	1,203	407,500	5,250	163,000	2,700	681,000	8,333
Total	134,171,700	712,655	138,496,400	750,282	146,091,850	819,419	155,566,000	922,147

The average value per thousand received for common brick in 1905 was $5.83, which is 38 cents greater than the average value of $5.45 per thousand of the 1904 production. The lowest value per thousand reported as having been received for common brick during 1904 was $4, which was received for 50,000 brick manufactured in Wake County, and the highest value per thousand was $9, which was received for 800,000 brick from Robeson County. The brick manufactured in the extreme eastern counties bring a relatively higher value than those manufactured in any other section of the State, principally on account of the higher cost of the brick imported into these counties. The number of manufacturers engaged in making brick in 1905 was 164, which is 15 less than the number, 179, engaged in this business in 1904. One thing to be noticed in connection with the manufacture of brick in North Carolina is that the larger companies are increasing their production and there is beginning to be a falling off of the very small producers.

In the following tables the total number and value of the different varieties of brick, including fire-brick, manufactured in North Carolina are given for the years 1905 and 1904 by counties:

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1905, BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE BRICK.	VALUE.
Alamance	4,275,000	$ 27,950		$		$
Anson	250,000	1,500				
Beaufort	2,425,000	14,850				
Bertie	75,000	450				
Bladen	125,000	750				
Buncombe	4,340,000	26,833	55,000	725	481,000	5,683
Burke	1,240,000	6,250				
Cabarrus	8,200,000	53,200	500,000	10,000	500,000	6,250
Caldwell	3,300,000	16,500				
Catawba	3,200,000	14,750				
Chatham	300,000	1,500				
Chowan	1,100,000	7,700				
Cleveland	825,000	4,800				
Columbus	2,075,000	12,500				
Craven	8,764,000	48,765				
Cumberland	3,000,000	16,500				
Davidson	3,000,000	19,000				
Duplin	40,000	263				
Durham	9,475,000	57,063				
Edgecombe	4,975,000	29,950	120,000	1,200		
Forsyth	10,283,000	55,915				
Franklin	2,300,000	14,500				
Gaston	2,220,000	11,520				
Greene	810,000	5,420				
Guilford	8,133,000	47,799				
Halifax	4,850,000	26,950				
Harnett	100,000	700				
Haywood	550,000	3,025				
Henderson	1,000,000	5,000				
Iredell	1,200,000	7,200				
Johnston	3,515,000	22,240				
Lenoir	700,000	3,500				
Lincoln	20,000	120				
McDowell	300,000	1,800	200,000	2,000		
Madison	125,000	625				
Mecklenburg	5,000,000	27,500				
Moore	1,809,000	9,854				
Nash	1,500,000	9,000				
New Hanover	2,750,000	16,500				
Orange	550,000	2,750				
Pasquotank	2,400,000	13,600				
Pender	500,000	3,000				
Perquimans	190,000	1,330				
Pitt	1,100,000	6,950				
Randolph	2,396,000	13,183				
Robeson	2,345,000	16,888				
Rockingham	2,450,000	14,450				
Rowan	3,760,000	21,800				
Rutherford	435,000	2,556				
Scotland	300,000	1,800				
Stokes	1,000,000	7,000				
Surry	870,000	5,080				
Union	3,674,000	19,900				
Wake	4,808,000	28,559				
Washington	100,000	800				
Wayne	10,750,000	59,563				
Wilkes	1,500,000	9,000				
Wilson	6,166,000	37,000				
Yadkin	167,000	838				
Total	153,610,000	896,289	875,000	13,925	981,000	11,933

NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1904, BY COUNTIES.

COUNTY.	COMMON BRICK.	VALUE.	PRESSED BRICK.	VALUE.	VITRIFIED AND FIRE BRICK.	VALUE.
Alamance	4,440,000	$ 25,750		$		$
Beaufort	2,840,000	17,000			30,000*	300
Bertie	1,475,000	8,850				
Bladen	300,000	1,800				
Buncombe	3,575,000	18,860	100,000	1,250	153,000†	2,600
Burke	550,000	2,800				
Cabarrus	5,350,000	26,750	100,000	1,000		
Caldwell	2,200,000	8,800				
Carteret	341,000	1,850				
Catawba	1,960,000	10,045				
Chatham	151,000	708				
Chowan	1,000,000	7,000				
Cleveland	915,000	4,800				
Columbus	2,000,000	10,300				
Craven	8,639,000	47,515				
Cumberland	1,750,000	9,500				
Davidson	1,075,000	5,300	5,000	75		
Duplin	26,000	174				
Durham	3,665,000	19,625				
Edgecombe	6,075,000	36,200				
Forsyth	5,380,000	28,540				
Gaston	3,500,000	19,400				
Gates	90,000	270				
Greene	60,000	420				
Guilford	13,450,000	78,368	50,000	500	100,000*	850
Halifax	4,100,000	24,000	125,000	1,250		
Harnett	250,000	1,450				
Haywood	800,000	4,400				
Henderson	2,000,000	10,000	30,000	300	300,000*	2,700
Iredell	995,000	5,250				
Johnston	2,840,000	15,800				
Lenoir	500,000	2,000				
Lincoln	1,225,000	6,300				
McDowell	450,000	2,700	200,000	2,000		
Macon	150,000	750				
Mecklenburg	3,500,000	21,000				
Montgomery	10,000	40				
Moore	2,900,000	16,400				
Nash	1,300,000	7,800				
New Hanover	2,750,000	17,125	800,000	10,000		
Orange	1,217,000	6,628				
Pasquotank	1,900,000	10,800				
Pitt	2,200,000	13,200				
Randolph	990,000	5,266			10,000†	100
Robeson	1,805,000	10,788				
Rockingham	7,580,000	38,075	100,000	1,000		
Rowan	4,100,000	23,000				
Rutherford	1,000,000	5,700				
Scotland	500,000	3,000				
Surry	1,325,000	6,375				
Transylvania	125,000	750				
Union	4,879,000	24,768				
Wake	5,717,850	31,479				
Washington	300,000	2,400				
Wayne	9,000,000	49,625				
Wilkes	1,500,000	7,500				
Wilson	5,273,000	30,500				
Total	143,988,850	795,494	1,510,000	17,375	593,000	6,550

*Vitrified brick.

† Fire brick.

Of the 97 counties in North Carolina, only 59 reported any production of brick. The county producing the largest number of brick in 1905 was Wayne, whose production was 10,750,000 valued at $59,563. Forsyth County was second with a production of 10,283,000 brick valued at $55,915, and Cabarrus County was third with a production of 9,200,000 brick valued at $69,450. This increased value is due to the number of fire-brick manufactured. In 1904 the first three counties were Guilford, Wayne, and Rockingham, with the following productions respectively: 13,450,000 valued at $78,368; 9,000,000 valued at $49,625; 7,580,000 valued at $38,075. The county producing the smallest number of brick was Lincoln with a production of only 20,000 brick valued at $120.

There is given in the table below the quantity and value of all the clay products produced in North Carolina from 1901 to 1905 inclusive:

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA IN 1901, 1902, 1903, 1904, AND 1905.

	1901.		1902.		1903.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	134,441,570	$697,861	131,611,700	$694,827	136,822,900	$ 731,802
Pressed brick	1,095,000	10,220	1,233,000	10,625	766,000	8,230
Vitrified brick	180,000	1,650	600,000	6,000	500,000	5,000
Fire-brick	55,000	550		1,203	407,500	5,250
Earthenware		4,490		658		612
Stoneware		17,453		13,854		13,700
Decorated ware		552				
Sewer-pipe, tile, etc.		55,745		72,618		100,989
	Tons.		*Tons.*		*Tons.*	
Kaolin	15,575	119,172	13,322	108,105	8,605	76,000
Fire-clay		100		215	231	875
Total value		907,793		908,105		942,458

	1904.		1905.	
	QUANTITY.	VALUE.	QUANTITY.	VALUE.
Common brick	143,988,850	$795,494	153,610,000	$ 896,289
Pressed brick	1,510,000	17,375	875,000	13,925
Vitrified brick	430,000	3,850	400,000	3,600
Fire-brick	163,000	2,700	681,000	8,333
Earthenware		438		387
Stoneware		13,462		12,932
Decorated ware				
Sewer-pipe, tile, etc.		110,800		102,445
	Tons.		*Tons.*	
Kaolin	9,110	76,670	10,988	85,622
Fire-clay	202*	761	107*	519
Total value		1,021,550		1,124,052

* Including ordinary stoneware clay sold crude.

The statistics given in this table regarding the clay production of the State do not perhaps represent the total output, for the reason that in many of the counties there are a few thousand brick made for local purposes regarding which it is extremely difficult or impossible to obtain any statistics, this being especially true where the brick are not for sale, but are used directly by those manufacturing them.

SUMMARY.

In order to compare the various mineral productions with each other and with the previous years, there is given in the following table the values of the various minerals produced in North Carolina for the years 1900 to 1905 inclusive:

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1900, 1901, 1902, 1903, 1904, AND 1905.

MINERAL.	VALUE.					
	1900.	1901.	1902.	1903.	1904.	1905.
Gold	$ 46,653	$ 60,411	$ 93,650	$ 113,604	$ 123,924	$ 129,153
Silver	15,986	34,024	30,212	16,907	19,132	20,216
Copper	41,600	76,900	212,553	67,037	36,600	88,000
Iron	42,000	4,997	52,771	78,540	79,846	70,352
Pyrite	14,625	32,000	--------	--------	--------	--------
Garnet	18,000	43,000	10,040	12,250	6,586	9,000
Corundum	36,840	48,840	--------			
Millstones	--------	--------	1,425	902	6,500	2,652
Mica Sheet	65,200	79,849	81,653	86,300	100,724	100,900
Scrap	36,262	14,200	2,919	2,400	3,410	3,375
Quartz	--------	7,500	11,250	36,827	36,269	13,659
Precious stones	12,020	24,245	5,300	1,525	10,600	3,350
Rare minerals	--------	--------	60	270	160	--------
Monazite	48,805	59,262	64,160	58,694	79,438	107,324
Zircon	--------	--------	360	570	200	1,600
Barytes	--------	22,615	44,130	21,347	33,930	21,670
Talc and pyrophyllite	42,000	77,974	88,962	76,984	65,483	74,940
Mineral water	--------	42,167	18,795	13,085	21,902	38,755
Graphite	--------	559	4,300	248	525	475
Coal	22,500	5,585	24,500	25,300	8,820	2,336
Stone	285,172	284,744	366,727	360,322	312,576	597,922
Sand and gravel	--------	--------	--------	--------	--------	547
Sand-lime brick	--------	--------	--------	--------	17,500	29,103
Kaolin	62,440	119,172	108,105	76,000	76,670	85,622
Clay products	815,975	788,618	800,000	866,458	944,880	1,038,430
Total value	1,604,078	1,821,276	2,021,872	1,915,570	1,985,675	2,439,381

This table shows the general increase in North Carolina's mineral production and emphasizes particularly the increase in the value of the production of those minerals in which North Carolina excels.

The 1905 production was obtained from 78 counties as compared with 76 counties in 1904, and in the following table the value of the productions for the years 1905 and 1904 in each county is given:

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1904 AND 1905.

County.	1904.			1905.		
	Mineral production, including kaolin.	Clay products, except kaolin.	Total.	Mineral production, including kaolin.	Clay products, except kaolin.	Total.
Alamance	$ 24	$ 25,750	$ 25,774	$-----	$ 27,950	$ 27,950
Alexander	150	-----	150	600	-----	600
Alleghany	-----	-----	-----	-----	-----	-----
Anson	304	-----	304	-----	1,500	1,500
Ashe	175	-----	175	830	-----	830
Beaufort	-----	17,500	17,500	-----	15,250	15,250
Bertie	-----	8,850	8,850	-----	450	450
Bladen	-----	1,800	1,800	-----	750	750
Brunswick	-----	-----	-----	-----	-----	-----
Buncombe	24,728	23,471	48,199	35,607	36,785	72,392
Burke	26,806	2,800	29,606	1,015	6,250	7,265
Cabarrus	15,083	27,750	42,833	23,489	69,450	92,939
Caldwell	10,047	8,800	18,847	-----	16,500	16,500
Camden	-----	-----	-----	-----	-----	-----
Carteret	-----	1,850	1,850	-----	-----	-----
Caswell	-----	-----	-----	-----	-----	-----
Catawba	5,544	14,520	20,064	3,581	16,705	20,286
Chatham	8,918	1,308	10,226	2,336	2,000	4,336
Cherokee	45,211	-----	45,211	29,459	-----	29,459
Chowan	-----	7,000	7,000	-----	7,700	7,700
Clay	2,458	-----	2,458	7,500	-----	7,500
Cleveland	32,682	4,800	37,482	73,017	4,800	77,817
Columbus	-----	10,300	10,300	-----	12,500	12,500
Craven	-----	47,515	47,515	-----	48,765	48,765
Cumberland	-----	9,500	9,500	-----	16,500	16,500
Currituck	-----	-----	-----	-----	-----	-----
Dare	-----	-----	-----	-----	-----	-----
Davidson	1,694	5,375	7,069	1,420	19,000	20,420
Davie	-----	-----	-----	3,850	-----	3,850
Duplin	-----	174	174	-----	263	263
Durham	-----	19,625	19,625	-----	57,063	57,063
Edgecombe	-----	36,200	36,200	-----	31,150	31,150
Forsyth	-----	28,840	28,840	-----	56,015	56,015
Franklin	90	-----	90	-----	14,500	14,500
Gaston	1,111	19,400	20,511	3,365	11,520	14,885
Gates	-----	270	270	-----	-----	-----
Graham	-----	-----	-----	-----	-----	-----
Granville	1,799	-----	1,799	12,000	-----	12,000
Greene	-----	420	420	-----	5,420	5,420
Guilford	12,899	189,718	202,617	9,108	145,299	154,407
Halifax	180	25,250	25,430	-----	26,950	26,950
Harnett	-----	1,450	1,450	-----	700	700
Haywood	36,500	4,400	40,900	35,210	3,025	38,235
Henderson	11,295	13,000	24,295	11,880	5,000	16,880
Hertford	-----	-----	-----	-----	-----	-----
Hyde	-----	-----	-----	-----	-----	-----
Iredell	240	5,250	5,490	2,063	7,200	9,263
Jackson	76,854	-----	76,854	79,350	-----	79,350
Johnston	-----	16,150	16,150	-----	22,490	22,490
Jones	-----	-----	-----	-----	-----	-----
Lenoir	-----	2,000	2,000	-----	3,500	3,500
Lincoln	1,841	10,270	12,111	-----	2,199	2,199
McDowell	27,190	4,700	31,890	20,153	3,800	23,953
Macon	47	750	797	2,000	-----	2,000
Madison	37,986	-----	37,986	23,185	625	23,810
Martin	-----	-----	-----	-----	-----	-----
Mecklenburg	1,183	21,000	22,183	7,462	27,500	34,962
Mitchell	109,466	-----	109,466	89,927	-----	89,927
Montgomery	51,362	390	51,752	62,650	-----	62,650

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1904 AND 1905—CONTINUED.

COUNTY.	1904.			1905.		
	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.	MINERAL PRODUCTION, INCLUDING KAOLIN.	CLAY PRODUCTS, EXCEPT KAOLIN.	TOTAL.
Moore	$ 5,860	$ 16,400	$ 22,260	$ 13,682	$ 9,954	$ 23,636
Nash	45	7,800	7,845	2,006	9,000	11,006
New Hanover	12,346	27,125	39,471	34,405	16,500	50,905
Northampton	----------	----------	----------	----------	----------	----------
Onslow	----------	----------	----------	----------	----------	----------
Orange	10,617	6,628	17,245	13,340	2,750	16,090
Pamlico	----------	----------	----------	----------	----------	----------
Pasquotank	----------	10,800	10,800	----------	13,600	13,600
Pender	----------	----------	----------	----------	3,000	3,000
Perquimans	----------	----------	----------	----------	1,330	1,330
Person	15,506	----------	15,506	----------	----------	----------
Pitt	----------	13,200	13,200	----------	6,950	6,950
Polk	13,738	----------	13,738	25,703	----------	25,703
Randolph	26,236	6,481	32,717	----------	14,093	14,093
Richmond	770	----------	770	2,000	----------	2,000
Robeson	----------	10,788	10,788	1,000	16,888	17,888
Rockingham	----------	39,075	39,075	----------	14,450	14,450
Rowan	127,774	23,000	150,774	334,454	21,800	356,254
Rutherford	5,904	5,700	11,604	34,320	2,556	36,876
Sampson	----------	----------	----------	----------	----------	----------
Scotland	----------	3,000	3,000	4,450	1,800	6,250
Stanly	17,271	----------	17,271	10,140	----------	10,140
Stokes	----------	----------	----------	3,000	7,000	10,000
Surry	110,466	6,375	116,841	219,883	5,080	224,963
Swain	57,258	----------	57,258	65,212	----------	65,212
Transylvania	----------	750	750	600	----------	600
Tyrrell	----------	----------	----------	----------	----------	----------
Union	9,902	25,168	35,070	4,977	22,400	27,377
Vance	8,000	----------	8,000	7,150	----------	7,150
Wake	525	31,479	32,004	475	32,684	33,159
Warren	361	----------	361	38,010	----------	38,010
Washington	----------	2,400	2,400	----------	800	800
Watauga	----------	----------	----------	350	----------	350
Wayne	----------	49,625	49,625	3,185	59,563	62,748
Wilkes	----------	8,694	8,694	63	11,320	11,383
Wilson	----------	30,500	30,500	----------	37,000	37,000
Yadkin	----------	----------	----------	----------	838	838
Yancey	35,300	----------	35,300	39,300	----------	39,300
Unknown	1,047	----------	1,047	2,189	----------	2,189
Totals	1,001,393	944,880	1,946,273	1,400,951	1,038,430	2,439,381

The value of the clay products, with the exception of kaolin, which is included with "Other Minerals," is given separately from the rest of the mineral production. As is seen from the above table, the following counties reported no production of mineral of any kind during 1905: Alleghany, Brunswick, Camden, Carteret, Caswell, Currituck, Dare, Gates, Graham, Hertford, Hyde, Jones, Martin, Northampton, Onslow, Pamlico, Person, Sampson, Tyrrell. Of these counties the following reported a production in 1904: Carteret, Gates, and Person. There were 5 counties, Davie, Perquimans, Stokes, Watauga, and Yadkin, which reported a production in 1905, but none in 1904.

Of the 78 counties reporting a mineral production for 1905, there were only 48 counties that reported anything besides clay products. Of the 59 counties reporting a production of clay, 16 counties did not report any other production. There were 20 counties reporting a mineral production which did not include any clay products. Rowan County reported the greatest value for its mineral production, excepting clay products, the value being $334,454; while Guilford County reported the greatest value of clay products, $145,299. The county reporting the greatest value for its total mineral production in 1905 was Rowan, with a value of $356,254. Surry County was second in the value of its total mineral production, which was $224,963. The lowest value reported by any county for its mineral production was $263 from Duplin County.

BLACK SAND INVESTIGATIONS.

CONCENTRATING PLANT.

There is now being installed at Chapel Hill, North Carolina, by the United States Geological Survey in coöperation with the North Carolina Geological and Economic Survey, a concentrating plant, whose primary object is a comprehensive investigation of the useful minerals contained in placer deposits, especially those containing what is known as the black sands; and in the sands along the Atlantic seacoast. The plant will also be used to test the pulp obtained by crushing ores from deep mines. Its object is really twofold, that of testing the gravels and ores and also of comparative tests of different concentrators, magnetic separators, etc., in order to determine satisfactory methods for concentrating these sands and separating the different minerals. The plant will be similar to the one erected at Portland, Oregon, during the Lewis and Clark Exposition, and which was maintained there by the United States Geological Survey to the first of October, 1906. Various concentrating tables, such as the Wifley, loaned by the Mines and Smelter Supply Company of Denver, Standard, etc., will be installed; also Wetherill and Blake-Morscher magnetic separators, loaned by the Wetherill Magnetic Separator Company of New York, and the Blake Mining and Milling Company of Denver, respectively; ore crushers, rolls and classifiers, which will permit of the treatment of any of the ores and gravels in order to determine exactly their mineral contents. A storage battery that has been built and loaned by the Electric Storage Battery Company of Philadelphia has also been installed.

The power for the plant will be generated by a gasoline engine loaned by the Fairbanks-Morse Company of Chicago. In connection with the concentrating plant there will be a well-equipped and complete assay laboratory, so that the actual values of gold, silver, platinum, and other metals that the ores may contain can be determined.

Many of these gravel deposits and sands contain, besides the precious metals, gold, silver, platinum, such minerals as magnetite, chromite, ilmenite, monazite, garnet, chrysolite, zircon, quartz, etc., which by means of the various machines can be separated not only from the precious metals, but from each other. Some of these minerals have a decided commercial value, and, as they can be separated from each other so as to give an almost pure product of each, they can be obtained in a marketable condition. There is more or less demand for them, depending upon the quantity of each that can be obtained. For the magnetite and ilmenite there may be an opening for use by the various electrical companies, such as the General Electric Company. The chromite, if it occurs in quantity in the sands, would have a decided value for use in the manufacture of chrome steel and chrome salts. Monazite and zircon have already been referred to in this report. The garnet, under certain conditions, would be of value for abrasive purposes.

It has been proved that it is possible to clean quartz sands, such as occur along seashores, so as to obtain a sufficiently pure sand for use in the manufacture of glass.

The method of treatment of the ore will of course vary greatly with the kind of sand. In this work the sands will be grouped into two general classes, (1) sea sands, river sands, and sand-dune material; and (2) low-grade gravels, tailings from dredges and placer workings and richer heavy tailings from the cleanup from sluice-boxes, dredges, etc. Another class of material that will be tested will be pulp from the crushing of various ores.

The samples will be assayed and then screened. The oversize will be examined and the undersize delivered to the concentrating tables, where it will be separated into three portions, concentrates, middlings, and tailings. These separate portions are all carefully examined and the concentrates will be separated on the Wetherill and Blake-Morscher magnetic separators. The Wetherill magnetic separator will separate the concentrates into six portions by five successively increased strengths of current. These minerals group themselves together in separate portions as follows: (1) magnetite, (2) chromite and ilmenite, (3) garnet, (4) olivine, hypersthene, and similar heavy silicates, (5) monazite and (6) non-magnetic residue containing zircon, quartz, iridium, iridosmium, gold and some of the platinum.

It is expected that the concentrating plant will be ready for operation soon after the first of January, and then samples of gravel and concentrates from 100 pounds up to 10 tons can be tested. Before any large samples are sent, however, small 4-pound samples should be forwarded for testing to determine whether they are worthy of further investigation. Those that give indications of containing minerals of economic value in commercial quantity will then be tested in larger quantity to determine the method of separation, etc. The following letter has been sent out regarding the forwarding of 4-pound samples to this office:

DEAR SIR:—The concentrating plant of the United States Geological Survey has just been established at Chapel Hill for testing the heavy sands (so-called black sands) of the Southern Appalachian region. Such sands are collected in the riffles in gold, monazite, and other placer mining. The Geological Survey has, in coöperation with the North Carolina Geological and Economic Survey, undertaken the examination of these heavy sands in order to determine what minerals they contain and if any of these are of economic importance. Tests will also be made as to the best methods of extracting these various minerals such as magnetite, chromite, garnet, monazite, rutile, topaz, zircon, gold, platinum, iridosmium, etc., the separation of some of which may prove to be permanent and profitable industries. The value of gold and silver in all the sands will be determined.

As a preliminary step in this investigation, will you mail to this office, using the accompanying franked envelope (which requires no postage) not more than four (4) pounds of the heavy sands which occur in your placer deposit? This material should be concentrated as well as you can do so before mailing in order to eliminate, as far as possible, the lighter minerals. As far as possible, you should send a record of the clay and the original gravel from which the concentrates were obtained; also exact information as to the name and post-office address of the sender, the name of the mine from which it came and the State, county, city, village, or district in which the deposit is located.

Care should be used to pack the dried sand securely for transmission through the mails, preferably by sewing up the sand in the bag and tying the envelope carefully to the bag. Do not send any samples of sand except where the sand occurs in sufficient quantity so that a ton or a car-load could be obtained, if desired.

Do not send any large samples of sand until instructed to do so by this office.

Yours very truly, JOSEPH HYDE PRATT,
Director of Concentrating Plant.

There are now over one hundred of these samples on hand, which will be tested shortly and the results obtained will determine the larger samples that will be asked for.

MINING LAWS OF NORTH CAROLINA.

On account of the many inquiries that have been received requesting information relating to the Mining Laws of North Carolina, the laws touching on this subject, as given in the Revisal of 1905, have been collected and are given in the following pages:

MINES.*

I. OPERATORS.

4930. *Lessor not held partner of lessee.* No lessor of property, real or personal, for mining purposes, although the lessor may receive a sum uncertain of the proceeds or net profits, or any other consideration, which, though uncertain at first, may afterwards become certain, shall be held as a partner of the lessee; nor shall any of the legal or equitable relations or liabilities of copartners exist between them, unless it be so stipulated in the contract between the lessor and lessee.

Code, s. 3292; R. C., c. 72; 1830, c. 46.

4931. *Not to employ minors under twelve.* No minor under twelve years of age shall be allowed to work in any mine, and in all cases of minors applying for work the agent of such mine shall see that the provisions of this section are not violated; and the inspector may, when doubt exists as to the age of any person found working in any mine, examine under oath such person and his parents, or other witnesses, as to his age.

1897, c. 251, s. 7.

4933. *To fence unused mines.* All underground entrances to any place not in actual course of working or extension shall be properly fenced across the whole width of such entrance so as to prevent persons from inadvertently entering the same.

1897, c. 251, s. 5.

4935. *Hoisting engines, how operated.* No owner or agent of any mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of mines persons employed therein any but experienced, competent, and sober engineers, and no engineer in charge of such engine shall allow any person except such as may be deputed for such purposes by the owner or agent to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties, and in no case shall more than two men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

1897, c. 251, s. 6.

4939. *Notice of opening or changing mines given.* The owner, agent or manager of any mine shall give notice to the inspector in the following cases:

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* Chapter 103, Revisal of 1905.

1. When any working is commenced for the purpose of opening a new shaft, slope or mine, to which this chapter applies. 2. When any mine is abandoned, or the working thereof discontinued. 3. When the working of any mine is recommenced after an abandonment or discontinuance for a period exceeding three months. 4. When a squeeze or crush, or any other cause or change, may seem to affect the safety of persons employed in the mine, or when fire occurs.

1897, c. 251, s. 7.

ACCIDENTS IN MINES.

4940. *Accidents; notice of, given.* The owner, agent, or manager of every mine shall, within twenty-four hours next after any accident or explosion, whereby loss of life or personal injury may have been occasioned, send notice, in writing, by mail or otherwise, to the inspector, and shall specify in such notice the character and cause of the accident, and the name or names of the persons killed, and injured, with the extent and nature of the injuries sustained. When any personal injury of which notice is required to be sent under this section results in the death of the person injured, notice in writing shall be sent to the inspector within twenty-four hours after such death comes to the knowledge of the owner, agent, or manager, and when such loss of life occurs in any mine by explosion, or accident, or results from personal injuries so received, the owner, agent, or manager of such mine shall notify the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person whose death has been thus caused, and inquire carefully into the cause thereof, and return a copy of the finding of the jury and all the testimony to the inspector.

1897, c. 251, s. 6.

4941. *Report to inspector.* The owner, lessee or agent in charge of any mine, any limestone quarry, or who is engaged in mining or producing any mineral whatsoever in this State, shall, on or before the thirtieth day of November in every year, send to the office of the inspector upon blanks to be furnished by him a correct return, specifying with respect to the year ending on the preceding first day of October the quantity of coal, iron ore, fire-clay, limestone, or other mineral product of such mine or quarry, and the number of persons ordinarily employed in or about such mine or quarry, below and above ground, distinguishing the persons and labor below ground and above ground.

1897, c. 251, s. 3.

4942. *Liable for injuries.* For any injury to person or property occasioned by any wilful violation of this chapter, or any wilful failure to comply with its provisions, by any owner, agent or manager of the mine, a right of action shall accrue to the party injured for any damage he may have sustained thereby; and in any case of loss of life by reason of such wilful neglect or failure aforesaid a right of action shall accrue to the personal representative of the deceased, as in other actions for wrongful death.

1897, c. 251, s. 6.

II. INSPECTOR.

4943. *Commissioner of Labor and Printing is, ex officio.* The Commissioner of Labor and Printing shall perform the duties of mine inspector as provided in this chapter.*

1897, c. 251, s. 1.

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* See Section 3910 of Chapter 84 of Revisal of 1905, Vol. II.

4944. *To examine mines.* It shall be the duty of the inspector to examine all the mines in the State as often as possible to see that all the provisions and requirements of this chapter are strictly observed and carried out; he shall particularly examine the works and machinery belonging to any mine, examine into the state and conditions of the mines as to ventilation, circulation, and condition of air, drainage, and general security.

1897, c. 251, s. 2.

4945. *May enter to make examinations.* For the purpose of making the inspection and examinations provided for in this chapter, the inspector shall have the right to enter any mine at all reasonable times, by night or by day, but in such manner as shall not unnecessarily obstruct the working of the mine; and the owner or agent of such mine is hereby required to furnish the means necessary for such entry and inspection; the inspection and examination herein provided for shall extend to fire-clay, iron ore, and other mines, as well as coal mines.

1897, c. 251, s. 2.

4946. *Death by accident investigated.* Upon receiving notice of any death resulting from accident it shall be the duty of the inspector to go himself, or to send a representative, at once to the mine in which said death occurred, and inquire into the cause of the same, and to make a written report fully setting forth the condition of that part of the mine where such death occurred and the cause which led to the same; which report shall be filed by the inspector in his office as a matter of record, and for future reference.

1897, c. 251, s. 6.

4947. *Keep record of examinations.* He shall make a record of all examinations of mines, showing the date when examination made, the condition in which the mines are found, the extent to which the laws relating to mines and mining are observed or violated, the progress made in the improvements and security of life and health sought to be secured by the provisions of this chapter, number of accidents, injuries received or deaths in or about the mines, the number of mines in the State, the number of persons employed in or about each mine, together with all such other facts and information of public interest, concerning the condition of mines, development and progress of mining in the State as he may think useful and proper, which record shall be filed in the office of the inspector, and as much thereof as may be of public interest to be included in his annual report.

1897, c. 251, s. 2.

4948. *Preserve papers.* He shall keep in his office and carefully preserve all maps, surveys, and other reports and papers required by law to be filed with him, and so arrange and preserve the same as shall make them a permanent record of ready, convenient, and connected reference.

1897, c. 251, s. 3.

4949. *To enforce law; counsel furnished.* In case of any controversy or disagreement between the inspector and the owner or operator of any mine or the persons working therein, or in case of conditions or emergencies requiring counsel, the inspector may call on the Governor for such assistance and counsel as may be necessary. Should the inspector find any of the provisions of this chapter violated or not complied with by any owner, lessee or agent in charge, unless the same is within a reasonable time rectified, and the provisions of this chapter fully complied with, he shall institute an action in the name of the State to compel the compliance therewith. The inspector shall exercise a sound discretion in the enforcement of this chapter.

1897, c. 251, s. 2.

4950. *Enjoin operations when law violated.* On application of the inspector, after suit brought as directed in the preceding section, any court of competent jurisdiction may enjoin or restrain the owner or agent from working or operating such mine until it is made to conform to the provisions of this chapter; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

1897, c. 251, s. 7.

4951. *Report to Governor.* The inspector shall annually make report to the governor of all his proceedings, the condition and operation of the different mines of the State, and the number of mines and the number of persons employed in or about such mines, the amount of coal, iron ore, limestone, fire-clay or other mineral mined in this State; and he shall enumerate all accidents in or about the mines, and the manner in which they occurred, and give all such other information as he thinks useful and proper, and make such suggestions as he deems important relative to mines and mining, and any legislation that may be necessary on the subject for the better preservation of the life and health of those engaged in such industry.

1897, c. 251, s. 3.

4952. *To what applicable.* The provisions of this chapter shall not apply to or affect any mine in which not more than ten men are employed at the same time; but the inspector shall at all times have free ingress to such mines for the purpose of examination, and shall direct and enforce any regulation in accordance with the provisions of this chapter that he may deem necessary for the safety of the health and lives of the miners employed therein.

1897, c. 251, s. 8.

III. WATERWAYS OBTAINED.

4953. *Water and drainage rights, how obtained.* Any person or body corporate engaged or about to engage in mining, who may find it necessary for the furtherance of his operations to convey water either to or from his mine or mines over the lands of any other person or persons, may make application by petition in writing to the clerk of the superior court of the county in which the lands to be affected or the greater part are situate, for the right so to convey such water. The owner of the lands to be affected shall be made a party defendant and the proceeding shall be conducted as other special proceedings.

Code, ss. 3293, 3294, 3300; 1871-2, c. 158, ss. 1. 3.

4954. *The petition, what to contain.* The petition shall specify the lands to be affected, the name of the owner of such lands, and the character of the ditch or drain intended to be made.

Code, s. 3294; 1871-2, c. 158, s. 3.

4955. *Appraisers; appointment, duties and pay of.* Upon the hearing of the petition, if the prayer thereof be granted, the clerk shall appoint three disinterested persons, qualified to act as jurors, and not connected either by blood or marriage

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with the parties, appraisers to assess the damage, if any, that will accrue to the lands by the contemplated work, and shall issue a notice to them to meet upon the premises at a day specified, not to exceed ten days from the date of such notice. The appraisers having met, shall take an oath before some officer qualified to administer oaths to faithfully perform their duty and to do impartial justice in the case, and shall then examine all the lands in any way to be affected by such work, and assess the damage thereto, and make report thereof under their hands and seals to the clerk from whom the notice issued.

Code, ss. 3295, 3296, 3299; 1871-2, c. 158, ss. 4, 5, 9.

4956. *Confirmation of report; payment of damages; rights of petitioner.* After the filing of the report and confirmation thereof by the clerk, who shall have power to confirm or, for good cause, set aside the same, the petitioner shall have full right and power to enter upon such lands and make such ditches, drains or other necessary work: *Provided,* he has first paid or tendered the damages, assessed as above, to the owner of such lands or his known and recognized agent, if he be a resident of this State, or have such agent in this State. If the owner be a nonresident and have no agent in this State, the amount so assessed shall be paid by the petitioner into the office of the Clerk of the Superior Court of the county for the use of such owner.

Code, s. 3297; 1871-2, c. 158, s. 7.

4957. *Registration of report.* The petitioner, or any other person interested, may have the report of the appraisers registered upon the certificate of the Clerk, and shall pay the Register a fee of twenty-five cents therefor.

Code, s. 3298; 1871-2, c. 158, s. 8.

SPECIAL LAWS RELATING TO COAL MINES.*

4932. *To furnish timber.* The owner, agent or operator of every coal mine shall keep a supply of timber constantly on hand, and shall deliver the same to the working place of the miner, and no miner shall be held responsible for accident which may occur in the mine where the provisions of this section have not been complied with by the owner, agent or operator thereof, resulting directly from the failure to deliver such timber.

1897, c. 251, s. 8.

4934. *Means of ingress and egress provided.* No owner or agent of any coal mine worked by shaft shall permit any person to work therein unless there are, to every seam of coal worked in such mine, at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it is not necessary for the two outlets to belong to the same mine if the persons employed therein have safe, ready and available means of ingress or egress by not less than two openings. This section shall not apply to opening a new mine while being worked for the purpose of making communications between said two outlets, so long as not more than twenty persons are employed at one time in such mine; neither shall it apply to any mine or part of a mine in which the second outlet has been rendered unavailable by reason of the final robbing of pillars previous to abandonment, as long as not more than twenty persons are employed therein at any one time. The cage or cages and other means of egress shall at all times be available for the persons employed when there is no second outlet. The escapement shafts shall be fitted with safe and available appliances, which shall always be kept in a safe condition, by which the persons employed in the mine may readily escape in case an accident occurs; and in no case shall an air-shaft with a ventilating furnace at the bottom be construed to be an escapement shaft within the meaning of this section. To all other coal mines, whether slopes or drifts, two such openings or outlets must be provided within twelve months after shipments of coal have commenced from such mine; and in case such outlets are not provided as herein stipulated, it shall not be lawful for the agent or owner of such slope or drift to permit more than ten persons to work therein at any one time.

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* Part of Chapter 103, Revisal of 1905.

1897, c. 251, s. 4.

4936. *Ventilation.* The owner or agent of any coal mine, whether shaft, slope or drift, shall provide and maintain for every such mine an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, which shall be circulated and distributed throughout the mine in such a manner as to dilute, render harmless and expel the poisonous and noxious gases from each and every working place in the mine, and no working place shall be driven more than sixty feet in advance of a break-through or airway, and all break-throughs or airways, except those last made near the working places of the mine, shall be closed up by brattice trap-doors, or otherwise, so that the currents of air in circulation in the mine may spread to the interior of the mine when the persons employed in such mine are at work, and all mines governed by this chapter shall be provided with artificial means of producing ventilation, such as forcing or suction fans, exhaust steam furnaces, or other contrivances of such capacity and power as to produce and maintain an abundant supply of air, and all mines generating fire-damp shall be kept free from standing gas.

1897, c. 251, s. 5.

4937. *Daily examinations; safety lamps.* Every working place shall be examined every morning with a safety lamp by a competent person before any workmen are allowed to enter the mine. All safety lamps used in examining mines, or for working therein, shall be the property of the operator of the mine, and a competent person shall be appointed, who shall examine every safety lamp before it is taken into the workings for use, and ascertain it to be clean, safe and securely locked, and safety lamps shall not be used until they have been so examined and found safe and clean and securely locked, unless permission be first given by the mine foreman to have the lamps used unlocked. No one, except the duly authorized person, shall have in his possession a key, or any other contrivance, for the purpose of unlocking any safety lamp in any mine where locked lamps are used. No matches or any other apparatus for striking lamps shall be taken into any mines, or parts thereof, except under the direction of the mine foreman.

1897, c. 251, ss. 5, 6.

4938. *Report of ventilation.* The mine foreman shall measure the ventilation at least once a week, at the inlet and outlet, and also at or near the face of all the entries, and the measurement of air so made shall be noted on blanks furnished by the inspector; and on the first day of each month the mine boss of each mine shall sign one of such blanks, properly filled with the said actual measurement, and present the same to the inspector.

1897, c. 251, s. 6.

GENERAL LAWS RELATING TO MINING.

3380. *Drains, obstructing, when necessary for mining.* If any person shall obstruct any drain or ditch constructed under the provisions of the law in regard to mines, he shall be guilty of a misdemeanor.

Code, s. 3301; 1871-2, c. 158, s. 12.

3797. *Mines.* If any person shall knowingly violate any of the provisions of the law relating to mines or shall do anything whereby the life or health of persons or the security of any mine and machinery is endangered, or if any miner or other person employed in any mine governed by the statutes shall intentionally or wilfully neglect or refuse to securely prop the roof of any working place under his control, or neglect or refuse to obey any orders given by the superintendent of a mine in relation to the security of a mine in the part thereof where he is at work and for fifteen feet back of his working place, or if any miner, workman or other person shall knowingly injure any water-guage, barometer, air-course or brattice, or shall obstruct or throw open any airways, or shall handle or disturb any part of the machinery of the hoisting engine or signaling apparatus or wire connected therewith, or air-pipes or fittings, open a door of the mine, and not have the same closed again, whereby danger is produced either to the mine or those that work therein, or shall enter any part of the mine against caution, or shall disobey any order given in pursuance of law, or shall do any wilful act whereby the lives and health of the persons working in the mines or the security of the mine or the machinery thereof is endangered, or if the person having charge of a mine whenever loss of life occurs by accident connected with the machinery of such mine or by explosion shall neglect or refuse to give notice thereof forthwith by mail or otherwise to the inspector and to the coroner of the county in which such mine is situated, or if any such coroner shall neglect or refuse to hold an inquest upon the body of the person whose death has been thus caused, and return a copy of his findings and a copy of all the testimony to the inspector, he shall be guilty of a misdemeanor, and upon conviction fined not less than fifty dollars or imprisoned in the county jail not more than thirty days, or both.

1897, c. 251, s. 8.

2000. *Mining and timber land leases.* If in a lease of land for mining, or of timbered land for the purpose of manufacturing the timber into goods, rent shall be reserved, and if it shall be agreed in the lease that the minerals, timber or goods, or any portion thereof, shall not be removed until the payment of the rent, in such case the lessor shall have the rights and be entitled to the remedy given by this chapter.*

Code, s. 1763; 1868-9, c. 156, s. 16.

MINERAL INTEREST IN LAND.

2488. *Separate partition of surface and mineral interests.* When the title to the mineral interests in any land has become separated from the surface in ownership the tenants in common of such mineral interests may have partition of the same, distinct from the surface, and without joining as parties the owner or owners of the surface; and the tenants in common of the surface may have partition of the same in manner provided by law, distinct from the mineral interests and without joining as parties the owner or owners of the mineral interests. And in all instances where the mineral interests and surface interests have thus become separated in ownership, the owner or owners of the mineral interests shall not be compelled to join in a partition of the surface interests, nor shall the owner or owners of the surface interests be compelled to join in a partition of the mineral interests, nor shall the rights of either owner be prejudiced by a partition of the other interests.

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* Section from Chapter 46, on Landlord, etc.

1905, c. 90.

2507. *Sale of mineral interests.* In case of the partition of mineral interests, in all instances where it shall be made to appear to the Court that it would be for the best interest of the tenants in common of such interests to have the same sold, or if actual partition of the same cannot be had without injury to some or all of such tenants in common, then it shall be lawful for and the duty of the Court to order a sale of such mineral interests and a division of the proceeds as the interests of the parties may appear.

1905, c. 90, s. 2.

LAWS RELATING TO PHOSPHATE ROCK.

1751. *Phosphate rock under navigable waters, when entered.* Any resident of this State who shall make affidavit before the Clerk of the Superior Court of any county through which such navigable stream may flow, that he has discovered in any navigable stream or waters of this State any phosphate rock or phosphate deposit therein, shall have authority and power to enter under the entry laws of this State so much of the bed of any such navigable stream or waters as shall not exceed in any one entry two miles in length up the middle of any such stream or water for the purpose of digging, mining or removing any such deposit or rock.

1891, c. 476.

1752. *How grant obtained; term; royalty.* Upon such affidavit being filed with the entry-taker, and upon a survey and plot being made of such entry by the county surveyor, as is now required by law in cases of entry of land, being made and certified to the Secretary of State with a copy of such affidavit and entry so made, the said Secretary of State shall issue a patent or grant to the said person, his heirs or assigns, for a term of twenty-five years for such land, with the proviso and condition inserted therein that the grantee therein shall pay to the Treasurer of the State at the end of every three months a royalty of one dollar per ton for each and every ton of the crude phosphate rock or deposit mined, dug or removed.

1891, c. 476, s. 2.

1753. *Exclusive right to mine; bond for royalty.* Such grantee, his heirs or assigns, shall have the exclusive right to mine, dig or remove any such phosphate rock or deposit for the term of twenty-five years from the date of said patent upon paying the said royalty of one dollar specified in said patent: *Provided, however,* that as a condition precedent to the granting of any such patent each such company or person making any such entry shall enter into bond with sufficient security in the penal sum of five thousand dollars, conditioned for the making of faithful and true returns to the Treasurer of the State of the number of tons of phosphate rock and phosphate deposit so dug, mined or removed, at the end of every month, and the punctual payment to the said Treasurer of the royalty of one dollar per ton upon each and every ton of the crude rock, without being steamed or

dried, at the end of every three months, and the said bond and sureties shall be subject to the approval now required by law for the bonds of State officers.
1891, c. 476, s. 3.

1754. *Navigation not obstructed by grantee.* No grant issued under the provisions of this subchapter shall confer upon the person receiving the same the right to obstruct the navigation of any such stream or water, nor confer upon any such person or his assigns any other right than that granted to take, mine or dig phosphate rock or deposit therefrom.
1891, c. 476, s. 4.

1755. *Fees for issuing grant for phosphate beds.* No fee or cost shall be charged or collected by the Secretary of State of any person or corporation receiving any patent or grant under this subchapter, except the fee allowed by law to the said Secretary of State for issuing a patent under the entry laws of the State.
1891, c. 476, s. 5.

1756. *Failure to operate for two years vacates grant.* Any person, company or corporation who shall fail to dig, mine or remove phosphate rock or deposit from any such stream or water to which he or it may be entitled under any patent or grant issued under the provisions of this subchapter for the period of two years from the date of said patent, or, after beginning digging, mining or removing the same, shall fail to continue to so dig, mine or remove the same for the period of two years, shall forfeit any and all rights therein granted, and said territory shall immediately thereupon become subject to entry under the provisions of this subchapter without making the affidavit of the discovery of any such deposits or rocks.
1891, c. 476, s. 6.

1757. *May be mined without grant, how.* Any person or corporation resident of this State shall have the right to mine, dig or remove phosphate rock or deposits from any of the navigable streams or waters in this State to which no exclusive patent or grant may have been issued, upon such person or corporation first entering into bond in the penal sum of five thousand dollars, payable to the Treasurer of the State, for the payment of the same royalty, in the same manner and under the same regulations as are prescribed in section one thousand seven hundred and fifty-three; but nothing in this section shall be construed to give to any such person or corporation any exclusive franchise or privilege to dig, mine or remove any such phosphate rock or deposit from any stream or water of this State.
1891, c. 476, s. 7.

3744. *Phosphate rock in rivers.* If any person shall dig, mine or remove any phosphate rock or deposit from any of the navigable waters of the State, except for the purpose of prospecting and discovering as allowed by law, he shall be guilty of a misdemeanor, and shall also forfeit and pay ten dollars per ton for every ton of phosphate rock or deposit so mined, dug, or removed, one-half to the use of the State and the other one-half to go to the informer.

MARL BEDS.

3796. *Marl beds, failure to enclose.* If any person shall open any marl bed without surrounding it with a lawful fence, he shall be guilty of a misdemeanor, and upon conviction shall be fined not exceeding fifty dollars or imprisoned not exceeding thirty days: *Provided,* this shall not apply to any person whose marl bed is enclosed inside his own enclosure.

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